ELISHA HANSON

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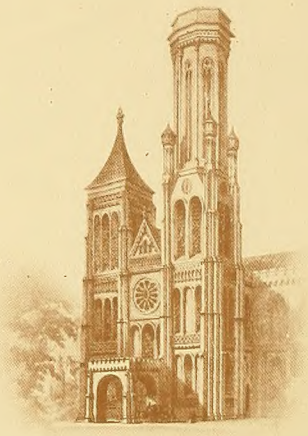

Given in memory of
Elisha Hanson
by
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THE NATIONAL GEOGRAPHIC MAGAZINE

THE ECONOMIC EVOLUTION OF ALASKA

BY MAJOR GENERAL A. W. GREELY, U. S. ARMY

AUTHOR OF "HANDBOOK OF ALASKA," ETC.

THE fact that Alaska is of economical importance to the rest of the United States is an opinion born of late years, which even yet is not widely disseminated. Indeed, the tenor of public knowledge on this subject was strikingly illustrated by a foot-note to an article by one of the best informed and highly esteemed of foreign writers on American subjects, whose reference to the Territory was printed, without accompanying comment, in one of the most influential and progressive periodicals of this country. The writer, referring to Alaska in 1905, said: "This vast region is inhabited by a few savages, and is not likely ever to support a population large enough to make its government a matter of practical consequence." Undoubtedly this statement represented the general opinion of intelligent men eastward of the Rocky Mountains.

It is, however, but one of the many instances in which leaders of American thought or opinion, illy informed as to Alaska, have indirectly characterized it as a land of gilded rainbows and unfulfilled promises, whose golden bonanzas are unsubstantial foundations for permanent communities, and that to there obtain a dollar in gold necessitates the expenditure of two others.

The writer holds no brief for Alaska, and makes no recommendations as to immigration or investments. In his *Handbook of Alaska* he has treated briefly such subjects of commercial interest as "Mining," "Fisheries," "Agriculture," "Forestry," "Trade and Transportation." He now yields somewhat reluctantly to the request of the NATIONAL GEOGRAPHIC MAGAZINE to consider the lines along which commercial progress in Alaska has proceeded, with pertinent comments on its interruption, diversion, and development.

The great Alaska-Yukon-Pacific Exposition is doing useful work in bringing the resources and possibilities of this valuable Territory to public notice, and many visitors will be brought to the realization that Alaska contributes its full share to the glory and support of the nation.

In considering the commercial aspects of this remote region, it is apparent that the products of Alaska, upon which all trade depends, have hitherto been drawn from three widely divergent sources—furs, fish, and gold—which will be separately considered.

WEALTH FROM FURS

Land and aquatic furs were the primary—indeed, the only—source of economical wealth in Alaska during its gov-

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FUR-SEAL ROOKERY ON SAINT GEORGE ISLAND, PRIBILOF, ALASKA

ernment by the Russians. Following the cession of the Territory, Congress followed the wise standing policy of Russia in adopting methods for the conservation of its extremely valuable aquatic furs. It made the Pribilof Islands, on which were situated the breeding grounds of the otary, or fur-seal, a closed reservation. As is well known, this reservation is leased for fixed periods of ten years each to the highest public bidder. The lessees are restricted as to the number and methods of taking the fur-seal, and are, moreover, bound to provide for the education and general welfare of the resident natives. This policy protected effectually the fur-seal until it faced practical destruction through pelagic sealing.

Trade in other aquatic fur-bearing animals, such as the beaver, muskrat, and otter, as well as the land fur-bearing mammals—the bear, marten, and foxes—was most fortunately controlled by a large and far-seeing corporation, the Alaska Commercial Company, which was free from an insatiate desire to exploit mercilessly the entire game of the country. In consequence the company instituted a reasonable trade policy, which looked to permanent and profitable relations with the native hunters through the years of the far future.

The entire fur trade, land and aquatic, under these fortunate conditions, began with a value of slightly over two millions of dollars, which continued until 1879, when, through the increase in the fur-seal values, it attained its maximum, averaging annually slightly over three millions of dollars for the three years from 1879 to 1881, inclusive. The average for ten years, 1879 to 1888, approximated two and three-quarters millions. Thenceforward there was a rapid decline, due almost entirely to pelagic sealing, so that in the past three years, despite a great increase in the value of furs, the entire annual catch has scarcely reached a million of dollars.

Under this judicious legislation of Congress the fur-seal was long conserved, with the prospect that it would be for centuries a permanent resource of the United States. For thirty years it yielded over one hundred thousand fur-seal skins annually, and for the five years ending with 1888, when pelagic sealing began systematically, the average was one hundred and five thousand.

It is unnecessary to dwell on the economic evils of pelagic or open-sea hunting, whereby the females are slaughtered, the young starve, and the herd perishes. The interests of the nation, of commerce, and of the individual suffer alike, while the resident natives are reduced to hopeless beggary and ultimate starvation.

Canada observes certain regulations as to season and limits, which somewhat alleviate the evils. The Japanese sealers, however, recognize no restrictions, and frequently go to extremes, invading American territory, slaughtering the fur-seal and plundering the rookeries—in short, imitating in a small way the piratical forays of the corsairs of the Middle Ages.

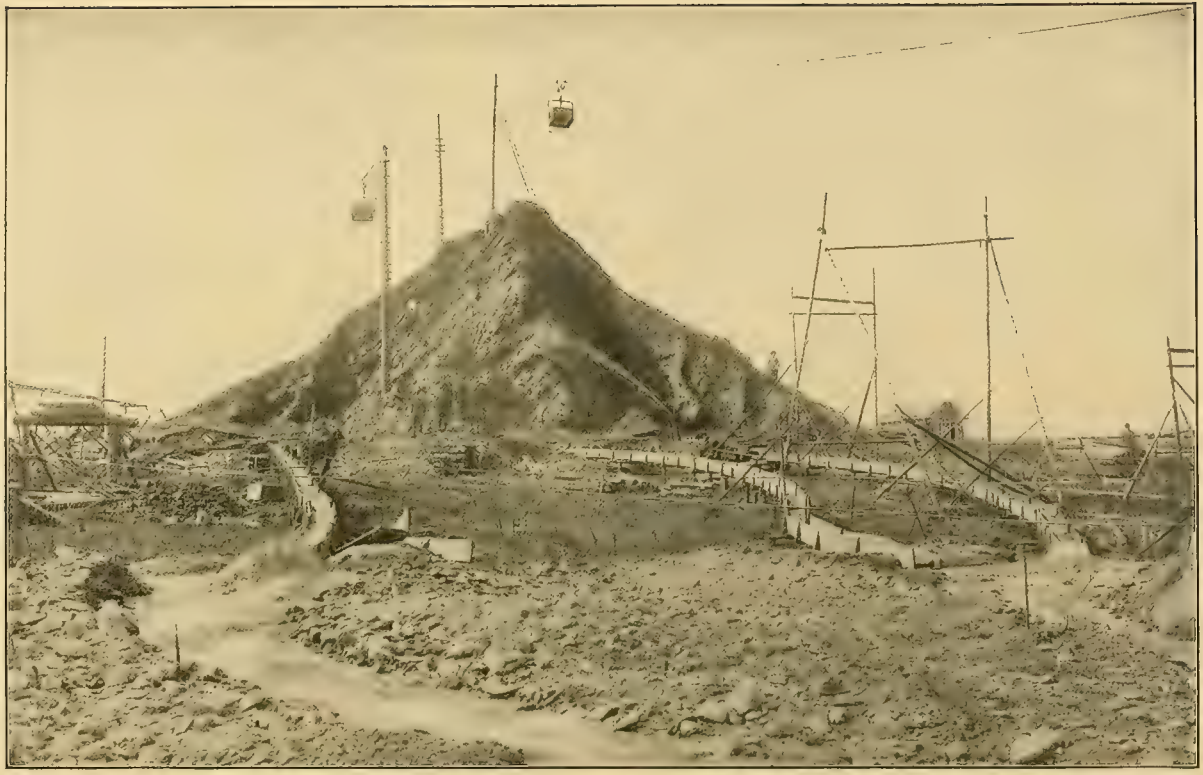
Under such unfriendly, as well as unwise, treatment, the American fur-seal herd has been practically annihilated, it having decreased 86 per cent, from an average catch of 105,000 to less than 15,000, during the past five years.

Thus vanish, through unwise and unfriendly alien exploitation, resources which for twenty years, from 1871 to 1890, produced fur-seal skins of an annual average value of one and a half millions of dollars.

Under stimulus of competition and invasion, the otter, land and sea, fell off from an average of 7,514 from 1881 to 1890 to 16 sea otter and 1,393 land otter in 1907, while the beaver similarly dropped from 6,094 annually to 1,159.

Fortunately the extent and physical features of interior Alaska afford better protection for the land animals than is possible for those of the sea. Nevertheless large immigration and improved methods of travel have affected seriously the fur-bearing mammals of the land, whose catch has fallen off 65 per cent, from an average of 106,214 from 1881 to 1890 to 46,320 during the past eight years.

Fortunately Alaska was becoming in a way independent of the fur trade as a



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PLACER MINING ON ESTER CREEK, NEAR FAIRBANKS

Washing up the dump, or frozen gravel, mined in winter

sole means of livelihood. Those who forecast commercial decay with the passing of the fur-seal were unfamiliar with the possibilities of the Territory. The seal merely gave way to the salmon.

FISHERIES

In 1868 America promptly entered the rich field of Alaskan fisheries, which in the first three years attained an average value approximating $300,000. The limited market made such a catch unadvisable, and the average fell to about $166,000 during the decade of 1871 to 1880.

A little later the market broadened in extent, and while there was a general development of the cod and halibut fisheries, there sprang into existence an industry of extraordinary importance—the canning of the salmon. From an insignificant value of $43,000 in 1881, the value of the salmon catch rose to $2,216,000 in 1889.

In short, the fisheries, principally of the salmon, showed in the decade of 1881 to 1890 an average annual increase of over $700,000 as compared with the catch of the previous decade. While the pelagic sealing most materially reduced the annual products of Alaska in five years to an amount of $1,800,000 annually, the steadily increasing values of the salmon fisheries saved the commercial situation. The salmon became second only to gold in value, financially and commercially, the catch reaching the astounding value of $10,185,783 in 1908.

GOLD

While gold is the most important of Alaskan minerals, yet copper, coal, and tin, in the order named, are destined to be factors of great economical importance in the near future.

At present the dominant interest in Alaska is that of gold mining. This industry began in 1880 in southeastern Alaska, where there has been conducted for thirty years the only very successful lode mining in the Territory. The most important of these operations is the well-known Treadwell mines, which is one of the largest, most productive, and best managed properties in the world. The output of this and adjacent mines now averages about $3,500,000 yearly. The entire mineral yields of Alaska from 1868 to 1908, approximate $150,000,000, of which about 30 per cent is from the Pacific coast belt (most largely from Treadwell mines, with about $34,000,000 to date); 3 per cent from Copper River and Cook Inlet region; 32 per cent from the Yukon Basin (principally from the Fairbanks district), and 35 per cent from the Seward Peninsula (Nome).

From an insignificant output of $20,000 in 1881, the gold yield had reached $2,500,000 in 1897, prior to the Klondike discoveries. It rose to $8,000,000 in 1900 and remained almost unchanged for several years, being followed by rapidly increasing amounts as follows: 1904, nine millions; 1905, sixteen millions; 1906, twenty-two millions; 1907, nineteen millions; and 1908, twenty millions.

While estimates as to future gold productivity are most uncertain, it appears that the possible output of Seward Peninsula alone may reach in values three hundred millions. The possible yields of the Tanana watershed, as now operated, have been estimated to be at least $100,000,000. Other known fields may bring the possible yields of existing mining districts up to the enormous sum of $500,000,000. These expert opinions clearly indicate the permanency of Alaska and the great importance that gold will play therein for many years. It should be borne in mind that not a tenth of Alaska has been "prospected," and that only high-grade placers are worked under existing conditions.

TOTAL PRODUCTS OF ALASKA, 1868 TO 1908

The following table, compiled from the most accurate sources, presents, in definite and concise form, the values of what may be called Alaska's contributions to the wealth of the world, it being confined entirely to export shipments from Alaska:

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FAIRBANKS TOWN, TANANA VALLEY, ON JULY 4, 1908

Year.	Furs.	Fisheries.	Minerals.	Totals.
1868–1870.....	$2,904,064	$908,320	None.	$3,812,384
1871–1880.....	20,918,041	1,864,298	$20,000	22,802,339
1881–1890.....	25,765,320	10,006,736	4,666,714	40,438,770
1891–1900.....	11,730,696	30,989,932	28,798,742	71,519,370
1901–1908.....	9,110,708	65,380,380	114,587,245	189,078,333
Aggregate.	70,428,829	109,149,666	148,072,701	327,651,196

This table illustrates the general trend of Alaskan products, and the consequent development of special industries associated therewith.

In the total values of $328,000,000 furs have contributed 21 per cent; fish, 34 per cent, and minerals 45 per cent.

As indicative of the importance of the fisheries, it is pointed out that it was not until 1899 that their values became subordinate to those of the minerals.

COPPER

The great copper resources of Alaska have been barely touched, the output to date scarcely exceeding $2,500,000. Up to 1908 there had been mined about 105 short tons of copper, of which 60 per cent came from Prince of Wales Island and the balance from Prince William Sound. About 1,000,000 short tons are said to be now in sight, and with promising prospects elsewhere it is certain that the copper yield of Alaska will enormously increase in the near future. The contiguity of copper and coal in the watershed of the lower Copper River offers unusual advantages for economical production.

COAL

The known coal-bearing areas exceed 100 square miles, but it is estimated that there are over 1,000 square miles in the Territory. Large areas near Controller Bay and in the Matanuska Valley are covered by high-grade anthracite and semi-anthracite coals, which must ultimately be of very great value to the entire Pacific Coast region. The entire coal tonnage of Alaska is estimated at fifteen thousand millions of short tons; of this sixteen hundred millions are anthracite and five hundred millions of short tons semi-anthracite.

While questions of title and transportation are at present unfavorable to early exploitation, there is no doubt that there will be a material coal output at an early day.

MISCELLANEOUS PRODUCTS

Among other products of lesser commercial importance, under existing conditions, may be mentioned petroleum, tin, lead, silver, gypsum, marble, iron, antimony, quicksilver, graphite, and mineral waters. Timber is exceedingly valuable for local purposes, but its exploitation for export is not at all probable; indeed, its shipment out of the Territory is forbidden by law.

While the widely distributed lignitic and high-grade coals make peat of no present value, yet it will some day be a valuable asset, it being generally present in great quantities. On the Alaska Peninsula it has been found a valuable fuel in places, owing to its being saturated with petroleum residue.

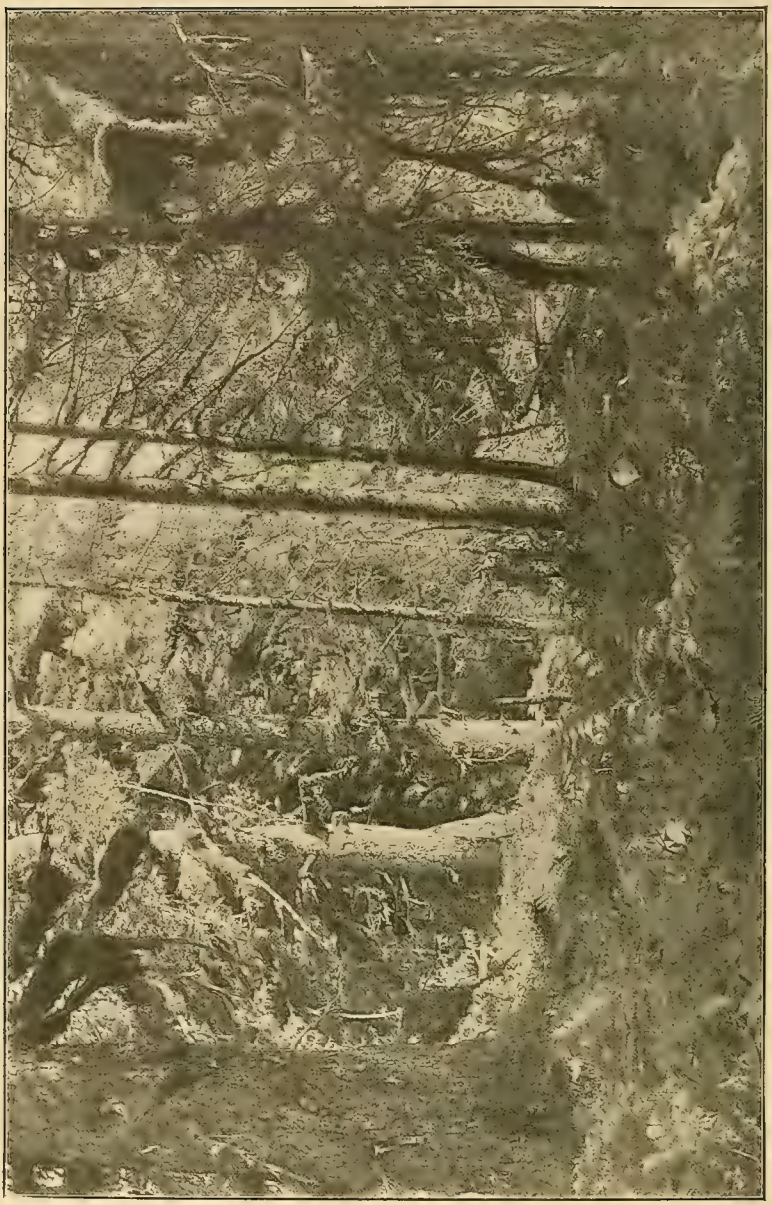
The four known petroleum fields have to the present been of local value only. The abundance and consequent low price of Californian petroleum makes competition for foreign markets impracticable for Alaskan producers.

On Prince of Wales Island there are large bodies of magnetite iron, estimated as aggregating about three millions of tons.

Silver, lead, and zinc are generally incidental to gold mining. As separate ore bodies they have not yet been commercially successful, though galena deposits are considered valuable today.

Marble is now quarried in large and steadily increasing quantities.

It must not be thought that the furs, fish, and minerals of Alaska are its only resources or products. There have been built and installed by Alaskan hands and from Alaskan materials eleven incorporated cities, which are modern in their equipment and permanent in their construction. The taxable values, which are thought by many to be about one-half the true values, aggregated in 1907 $10,000,000, and the value of property in the unincorporated settlements reaches at least five millions more. The 350 miles of



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GROWING FOREST ON MALASPINA GLACIER, NEAR MOUNT SAINT ELIAS

constructed railways, on the low basis of $50,000 per mile, have cost about $17,500,000, and the cost of steamships, telephones, telegraphs (omitting the $2,000,000 plant of the United States), stage equipment and stock doubtless carries the values for transportation services alone up to $25,000,000. Ditches have already cost about $6,000,000. The output of timber and game for local purposes can scarcely be less than $2,000,000 annually, while the wood and coal locally used is not less valuable. Doubtless the agricultural products of Alaska, including dairy, stock, and fodder, reach in value between one and two millions yearly.

The commercial importance of a number of towns, such as Ketchikan, Juneau, Nome, and Fairbanks, is far beyond the usual ideas of mining camps. Take Fairbanks: Steam heated from a central plant, with water-pressure fire system, electric appliances of all kinds, with machine-set newspapers, hospitals, schools, churches, with a municipal budget of about $100,000 annually, and without debt.

It should be remembered that in these data and discussions there have not been taken into consideration the subsistence and other materials involved in the life of the 27,000 natives, whom no well-informed individual can call either savage or vicious.

TRADE

The extent, value, and scope of Alaskan trade astonishes every person who becomes acquainted with its details. As indicative of the somewhat harassing conditions under which petty trade is done, it may be stated that it is imperatively required that the trader shall have a federal license. For such licenses the people of Alaska paid in 1907 no less than $384,395.

The shipping manifests show that in 1903 the import trade of Alaska amounted to nearly ten millions of dollars. Four years later it aggregated twenty millions, slightly more than double the amount of 1903. In 1907 the purely American shipments to Alaska exceeded those to Hawaii by four millions of dollars, and those to the Philippines by thirteen millions.

These facts conclusively indicate the commercial value of Alaska, which promises to steadily advance in its population, its trade, and in all phases of a higher and better civilization.

MARKING THE ALASKAN BOUNDARY

By Thomas Riggs, Jr.

Chief of Party, U. S. Alaskan Boundary Survey

With Photographs by Boundary Survey Parties

THERE had been some dispute as to what constituted the boundary of the country bought from Russia by the United States in 1867, but until the real value of the territory was known, no one cared. The miners of the early days managed very well with an approximate boundary. They held miners' meetings and any decision reached by them constituted the law.

For the opening up of Alaska we are indebted to the panic of 1893. Throughout the West the hardier spirits preferred to brave the dangers of that almost unknown region than to accept the starvation wages then offered. They knew that grubstakes and independence were to be found on the bars of the Forty Mile, the Stewart, and at Circle City.

With the increase of population came

OBSERVING FROM "BLACK TIP," A TRIANGULATION POINT NEAR THE COAST Photo by T. Riggs, Jr.

The surveyor had to balance on his toes over a sheer drop on the other side of about 75 feet. Note the trail on the snow made in the ascent

the representatives of the American and Canadian governments, custom-houses were established and court decisions took the place of the rude justice dispensed by miners' meetings. With the new order of things came also the necessity of a determined line between the two countries.

The United States claimed, under the old Russian treaty, a line running up Portland Canal to the 56th parallel of north latitude, thence to follow the summit of the coast range to its intersection with the 141st meridian. In the absence of a definite mountain range near the coast, the line was to be not more than ten marine leagues distant from tide water.

Canada claimed that the line should follow the coast range paralleling the general contour of the coast, and cutting across all inlets and fiords.

There were other contentions of minor importance, but the real trouble was that Canada thought she was entitled to a seaport which would allow of shipments through Canadian territory to the now valuable Klondike.

As to the 141st meridian being the rest of the boundary, there was no dispute. This line starts at a ridge of Mount Saint Elias and runs through to Demarcation Point on the Arctic Ocean.

Maps showing a strip of land along the coast were made, archives were rummaged, every available bits of history and tradition were searched, and the whole mass submitted as evidence to a tribunal of three Americans, two Canadians, and one Englishman, which met in London in 1903.* The sifting of the evidence required months. The opposing counsel helped by the geographic experts put forth their best arguments, a vote was taken, and the result showed four to two for the United States, the Lord Chief Justice of England, Lord Alverstone, casting his vote with the Americans.

* For an account of this famous boundary dispute see "The Alaskan Boundary," by John W. Foster, formerly Secretary of State, November, 1899, NAT. GEOG. MAG., and "The Alaskan Boundary Tribunal," by John W. Foster, January, 1904, NAT. GEOG. MAG.

Photo by T. Riggs, Jr.

TRIPOD OBSERVING PLATFORM AND TRIANGULATION SIGNAL

Black Sand Island, near Yakutat Bay. A station elevated so as to look over near-by timber. The instrument tripod is separate from the observing platform, so that there shall be no jar. Built from drift wood. The barrel was picked up on the beach.

Naturally the Canadian representatives felt greatly disappointed, but the evidence was too conclusive to allow of any other outcome.

Then came the question of what mountains constituted the coast range. In places a compromise was effected departing slightly from the claims of the United States.

It was decided that certain well-defined peaks on the mountains fringing the coast should constitute the main points on the boundary. Lord Alverstone, wielding a

blue pencil, marked on the maps what appeared to the tribunal to be the proper mountains. The members of the tribunal were all eminent jurists, but this did not make them proficient in the intricacies of contour maps, and the advice of the experts was constantly requested.

The location of the boundary was left to two commissioners, Mr O. H. Tittmann, Superintendent of the Coast and Geodetic Survey, for the United States, and Dr W. F. King, Chief Dominion Astronomer, for Canada.

Wherever the blue-pencil mark appears on the map, this point without any recourse is a boundary point, even though a higher and better point may be but a short distance away.

To follow the sinuousities of the mountain ranges in this country would be hopeless, so the commissioners will probably decide that a straight line connecting the various blue-penciled points shall constitute the boundary.

The actual demarcation of the boundary, to be satisfactory to both governments, must be done jointly. By this it is not meant that there is a division of labor in every party. There are American parties and Canadian parties, and with each locating party, or party which decides on the line, go representatives of the other government. There are line-cutting parties, leveling parties, topographic parties, triangulation parties, and monumenting parties, which work separately, their work being such that joint representation is not always necessary, as the line will be subject to inspection at some later date. These parties report yearly to the commissioner of their respective governments. The commissioners meet sometimes in Washington and sometimes in Ottawa, and either accept or reject the work done by the field parties. Their decision is final.

A LINE 1,200 MILES LONG MUST BE MARKED

The magnitude of the task is little understood except by those closely connected with the work.

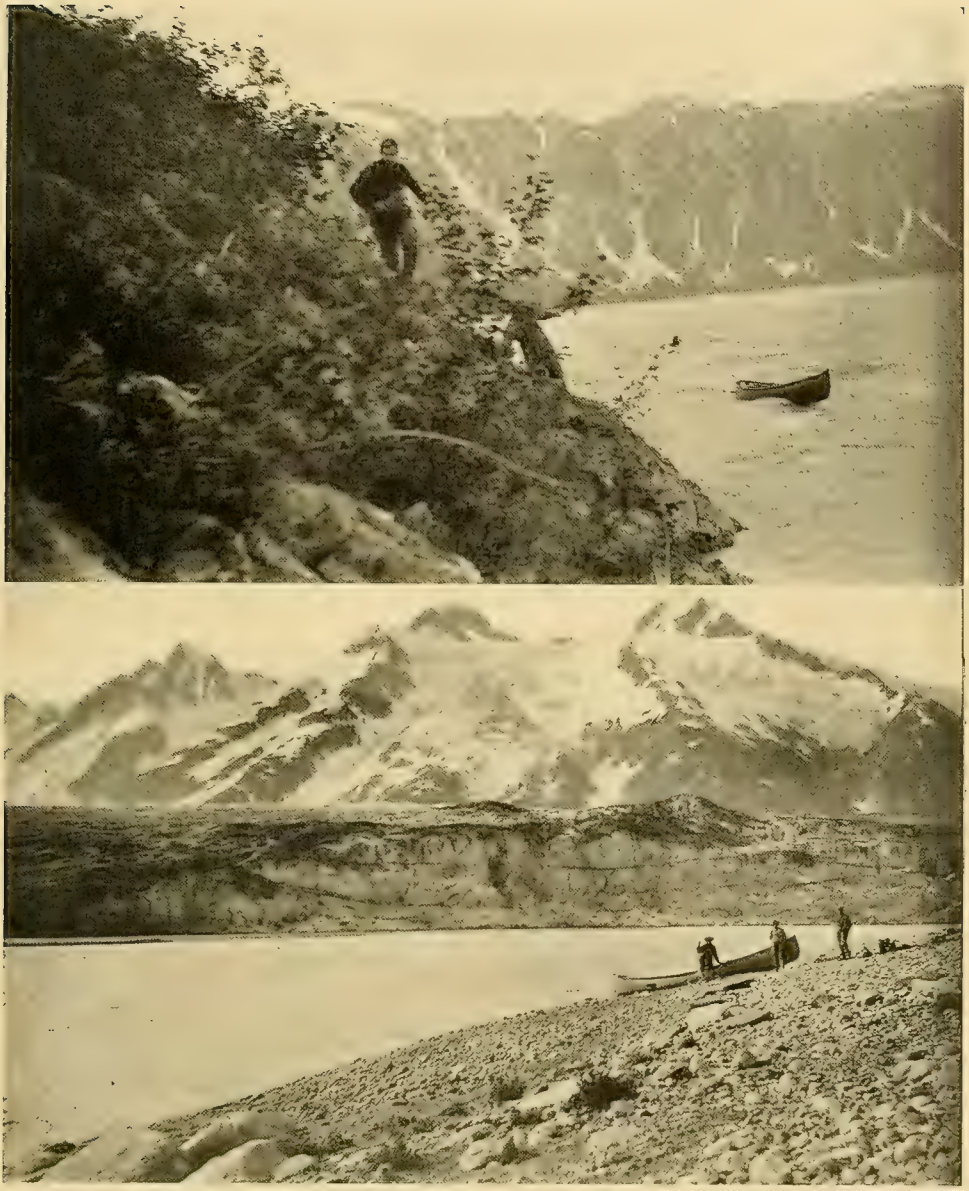
There are 600 miles of boundary from Portland Canal up the coast to Mount Saint Elias, where it hooks around on to the 141st meridian and shoots for another 600 miles straight north to the Arctic Ocean.

All the land lying along the boundary must be mapped on an accurate scale, and a strip of topography four miles wide must be run the entire length of the 141st meridian; peaks which cannot be climbed, or rather those which would take too long and would be too expensive to scale, must be determined geodetically; vistas 20 feet in width must be cut through the timbered valleys, and monuments must be set up on the routes of travel and wherever a possible need for them may occur.

The field season is short, lasting only from June to the latter part of September, and along the coast operations are constantly hindered by rain, snow, and fog. Rivers abounding in rapids and quicksands have to be crossed or ascended. A man who has never had the loop of a tracking line around his shoulders little knows the dead monotony of lining a boat up a swift Alaskan river with nothing to think of but the dull ache in his tired muscles and the sharp digging of the rope into his chafed shoulders.

Vast glaciers are to be crossed, with their dangers of hidden crevasses. More than one surveyor has had the snow sink suddenly beneath his feet, and has been saved only by the rope tying him to his comrades. Several have been saved by throwing their alpine stocks crosswise of the gap, and one, while crossing the Yakutat glacier with a pack on his back, caught only on his extended arms. High mountains must be climbed; if they are not the boundary peaks themselves, they must be high enough to see the boundary peaks over the intervening summits.

And these climbs are not the organized expeditions of an Alpine club, with but one mountain to conquer, but daily routine. Heavy theodolites and topographic cameras must be carried, and instead of being able to throw himself down to rest and enjoy the glorious panorama, there is immediate work to be done, and a few clouds hovering over some distant moun-

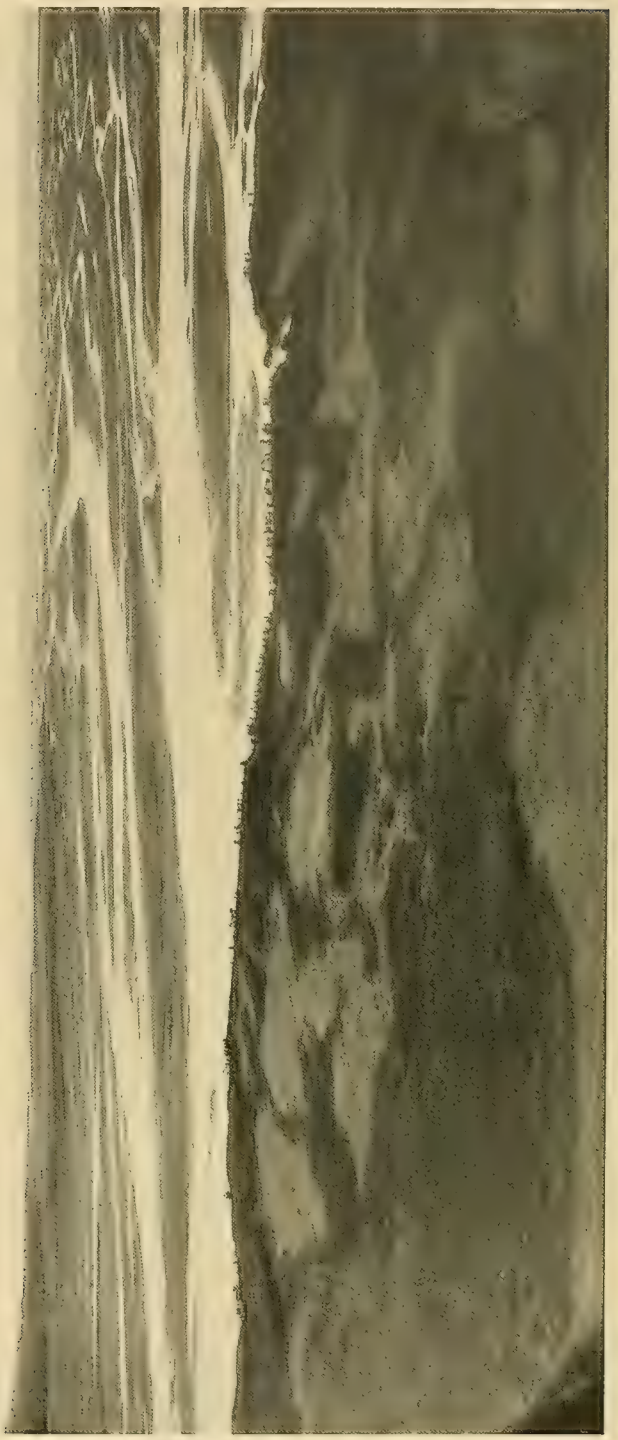


TRACKING UP THE ALSEK RIVER Photos by E. R. Martin

The canoe is steered from the shore by means of lines at either end

ALSEK (LIVE) GLACIER ON THE ALSEK RIVER

These glaciers make river navigation extremely dangerous. A falling cake of ice may swamp a canoe passing too near the face



DELTA OF THE ALSEK RIVER, SHOWING THE MANY CHANNELS OF THE RIVER Photo by L. Netland

tain, instead of lending beauty to the view, may send the poor surveyor behind some sheltering rock to wait, shivering with cold, until morning will allow him to take up his stand by the theodolite and complete his observations.

On the 141st meridian an astronomic longitude was determined at a point on the Yukon River. American and Canadian astronomers worked together, bringing time over the wires both from Seattle and Vancouver. An azimuth was then observed and this azimuth is being prolonged in its straight shoot across the peninsula. This line has been accepted as the 141st meridian and consequently the boundary. It has been run into the mountains fringing the Pacific coast. Topography, triangulation, line-cutting, and monumenting are now being carried along the located line.

For the present the line will not run to Mount Saint Elias. It would be possible, but not practical, to run it across the intervening eighty miles of snow and ice and towering mountain ranges. To complete this part of the boundary the use of an airship is contemplated.

Photo by G. C. Baldwin

UNLESS PROVISIONS ARE PUT IN AN ELEVATED CACHE, BEARS AND FOXES SOON STEAL THE WHOLE SUPPLY

SWAMPS AND RIVERS TO BE OVERCOME

In the interior the difficulties of the work are changed. Long wooded stretches, interrupted by barren ridges, take the place of glaciers and craggy mountains. In place of snow fields there are heart-breaking "nigger-head" swamps to be crossed, where the packhorse becomes mired and exhausted and the temper of man is tried to the breaking point. Supplies have to be ferried across the rivers on log rafts, while the horses swim. Clouds of poisonous mosquitoes and gnats arise from every pool and every clump of moss, driving horses frantic and men to distraction.

There is no longer the guiding line of the coast to follow, and the surveyor must rely on his instinct for topography and woodcraft to pilot him through an unbroken wilderness.

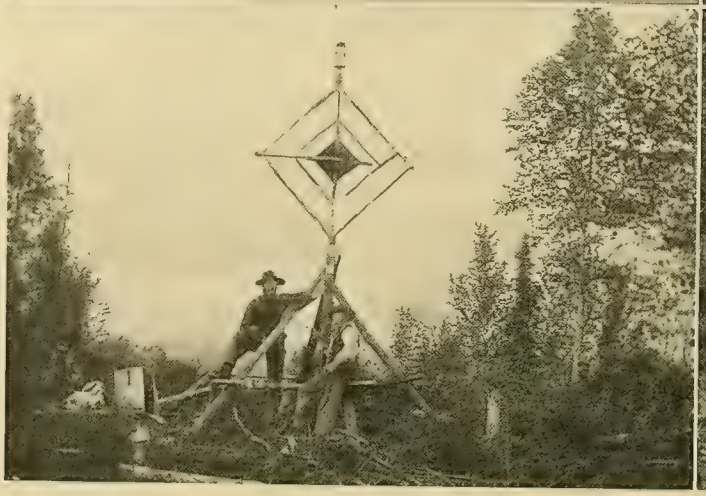
The inconveniences of transportation have to be overcome, and year by year they are becoming worse as the work carries us each year farther from the Yukon with its steamers. For the season of 1909 the American party of thirty men will have to walk 300 miles before they can even start work.

Then the topographer with his plane-table and the triangulator with his theodolite try to make up for lost time. Regular hours for work are ignored. A day's work is reckoned as ten hours, if the work can be done in that time; if not—well, in midsummer the days are twenty-four hours long. Holidays and Sundays see the same old routine—even the Fourth of July. It is a saying in camp

TAKING ADVANTAGE OF A FAIR WIND

On the portage between the Arku-Klin and Dangerous Rivers. As the route is largely over quicksands, an ordinary wheel would be impracticable. A substitute for wheels is found in empty oil barrels—picked up on the beach—which have floated away from some salmon cannery.

A SMOKE-HOUSE FOR PROTECTION AGAINST MOSQUITOES AND GNATS



A POINT ON THE 141ST MERIDIAN

The two surveyors are the American and Canadian representatives,

MINERS, PROSPECTORS, AND SURVEYORS ARE ALLOWED TO KILL GAME IN ANY SEASON

To their credit may it be said that they seldom abuse their privilege. Photos by G. C. Baldwin and T. Riggs, Jr.

Photo by A. Mosheim

MOUNT COOK (13,803 FEET), MOUNT VANCOUVER (15,715 FEET), AND MOUNT HUBBARD (16,400 FEET)
From the summit of Mount Tebankof. These are all boundary peaks

MARKING THE ALASKAN BOUNDARY Photo by T. Riggs, Jr.

Through wooded stretches the timber is cut out for 10 feet on each side of the boundary. About 300 miles of forest boundary vista similar to that shown in this picture has been cut by the boundary survey parties.

Photo by G. C. Baldwin

NEAR THE BOUNDARY CROSSING OF THE WHITE RIVER

The straight line shows how the 141st meridian disregards the comforts of the surveyors. Mount Natazhat shown in hazy outline a little to the right of the boundary

that "it always storms on Sunday," but every storm does not bring a Sunday. Camps can be moved in a storm, and the topographer carries a small silk covering shaped like an umbrella to rig over his plane-table for showers, while the observer on triangulation has a small silk "dog" tent into which he may crawl until the rain is over.

Pack trains are constantly on the move, carrying their heavy loads of outfit supplies, while the picturesque language of the Western packer makes known the physical and psychic shortcomings of each and every animal.

Usually bases of supply are established at certain known points before the opening of the season. These are called "caches." Mistakes in the locating of a cache are sometimes made, and last season one surveyor in consequence of such a mistake was without food for two days, finally reaching another camp in rather disheveled condition. It so happened that this other party was moving south toward the same cache and was on short rations; so nothing remained to do but beat a hurried retreat 60 miles northward, arriving at another base with belts pulled in to the last notch.

To give some slight idea of the amount of work accomplished in a season, the American and Canadian parties along the 141st meridian, during the season of 1908, located main points on the boundary for 85 miles, completed 77 miles of triangulation, a belt of topography 65 miles long, cut 40 miles of vista, ran some 250 miles of levels, and set 17 monuments.

While getting in to work is quite a problem, getting out is nearly as serious. It may happen that most of the horses have died during a season. A small party of packers then drive out the surviving animals, while the main party

MOUNTAINS SURROUNDING DISENCHANTMENT BAY Photo by A. Mosheim

When Malaspina was looking for the Northwest Passage he thought he had found it in Disenchantment Bay until he reached the point shown in the picture. Here further progress was stopped by a glacier which has since receded; hence the name

THE DISCHARGE OF THE ALSEK GLACIER, WITH MOUNT FAIRWEATHER IN THE BACKGROUND Photo by L. Netland
Mount Fairweather is a boundary peak; elevation, 15,360 feet

Photo by W. B. Reaburn

TYPE OF ALUMINUM-BRONZE MONUMENT USED ON THE MORE IMPORTANT POINTS ALONG THE BOUNDARY, SUCH AS MAIN CREEK CROSSINGS, WADS, ETC.

This monument is 5 feet high and is set in a concrete base weighing about 1,500 pounds

must get out as best they may. This is usually done on rafts. Dry logs are cut and pinned or lashed together, a sweep is put on each end, the outfit is secured in the middle, one man takes his place at the bow, another at the stern, the others distribute themselves over the cargo, and the voyage commences. No one knows the condition of the streams to be floated down. Rapids and shallows may exist; a log jam may close up the channel; overhanging "sweepers" or low bending trees line the banks and must be avoided. To change the course of a raft, it must be rowed sidewise away from the direction the current is setting it. Sometimes it runs aground, and then all must pile overboard into the icy water and work with pries until it is shoved into the deeper water of another current.

While one naturally first speaks of the hardships or seeming hardships, still camp life has its pleasures and compensations for the surveyor.

When day by day the work in hand shows another step toward completion, another stream zig zags across the map, another mountain is shown, another station occupied, something accomplished; when at night he lounges at ease before the blazing camp fire, watching the sparks snakily flashing against the dark foliage; when he wanders over the mountains and breathes the fresh air and quenches his thirst in some pure and ice-cold spring; when the inhabitants of some virgin stream are lured from their hiding places by the makeshift fly of ptarmigan feathers and string; when a juicy venison steak repays a well-directed bullet—then the small conventions and petty jealousies of civilized life fade away, and his labors are requited, and through his own exertions he is getting the best out of the life assigned to him.

On the maps, the boundary is shown all along by nice little dotted lines, but the work of putting this line on the ground is still in progress, and both American and Canadian surveyors are putting forth their best efforts to establish a boundary which will stand the test of time; so that when a hundred years hence the engineer of the period throws in his equilibrium clutch, turns on the gravity and air current absorber and brings his huge "dirigible" to a stop above some one of our stations, he may look through his improved surveying instruments along the vista from the Arctic to Mount Saint Elias and pronounce the line laid out by the old-timers straight and good.

A MOSQUITO VEIL Photo by T. Riggs, Jr.

When mosquitoes and gnats are particularly bad, every one must wear veils, otherwise life would be unbearable. These veils are made so as to fasten down tightly around the body. The wide-brimmed hat keeps the veil from touching the face.

CHARTING A COAST-LINE OF 26,000 MILES

WHEN in 1867 the United States acquired Alaska from Russia it added to its domain the vast area of 590,884 square miles, two of its dependent islands being larger than Porto Rico.

From the point of view of the marine cartographer, the most important feature of Alaska is its great extent of coast-line. Along its general trend it measures 4,700 miles, but as the charts must show the shores of the islands and follow the ins and outs of the curves of the gulfs and bays, the length of coast-line to be surveyed reaches the enormous total of 26,376 miles. This is six times the length of the coast of France; fifteen times that of Germany; nearly eleven times that of Italy; over three times the combined length of our Atlantic, Gulf, and Pacific coasts, and is equal to five-eighths of the entire coast-line of Great-Britain and her colonies.

If a map of Alaska were to be constructed in one piece, on a scale of 1-80,000, nearly an inch to the nautical mile, and a popular scale for a coast chart, it would be 158 feet long by 105 feet wide.

At the time of the transfer of Alaska few people were interested in the territory or anticipated its future value. In fact, a special agent of the Treasury, in his report on its resources in 1869, without doubt voiced the popular opinion of the day when he advised abandoning the territory as not worth the trouble and money expended upon it.

This lack of interest continued until 1880, and during this period there was no demand for charts and no attempt was made to inaugurate a systematic survey. Compilations from the work of the early Russian and English explorers were made, and explorations were continued under our own auspices. But in 1880 Juneau's discovery of gold in Douglas Island quickly altered this state of affairs, and the great rush to many different and widely separated points on the coast began.

Immediately the inadequacy of the compiled charts became apparent. Although the work of the explorers is worthy of admiration when its amount is considered, as well as the small means with which it was accomplished and the great difficulties overcome, yet, when tested by the needs of actual traffic, the results were found to be far too meager for safe navigation. On this account for certain points vessels could not be engaged at all, for others only at exorbitant rates, and for all points the insurance premiums were high. Hence there arose an urgent demand for accurate and detailed charts—a demand which is continuous, developing new and larger wants to succeed those already satisfied.

The problem to be solved by the Coast and Geodetic Survey has been one where a nice balance had to be established between accuracy on the one hand and the pressing need for large results on the other.

Instead of being able to concentrate its field force on one portion of the coast and accomplish a steady advance with uninterrupted sequence season after season, it has been constrained to scatter its parties and follow the erratic movements of the prospector and miner.

Owing to Juneau's discovery and the development of the salmon-canning industry, the Alexander Archipelago first claimed attention. The survey of its 11,000 islands, separated by countless waterways, was in progress when the Klondike strike was made, and Saint Michaels, 1,800 miles away, became a new objective point for ocean freights, thence to be shipped up the Yukon River.

From Puget Sound to Saint Michaels the sea route crosses the Aleutian Archipelago, where large scale charts of the thoroughfares were needed. It passes by Nunivak and Saint Lawrence islands, and therefore the positions and characteristics of their nearest headlands must be laid down. Not only were the approaches to Saint Michaels surveyed, but an exhaustive examination of the delta

of the Yukon was also made in the vain hope of discovering some channel of sufficient depth for ocean steamers, and thus save the light-draft river boats the exposed trip around to Saint Michaels.

In chronological order the next mining stampede was to Nome. The field parties followed soon after the prospectors, and continued their work until the whole of Norton Sound was completed.

Latterly copper and coal interests have developed in Prince William Sound and Cook's Inlet, and surveying operations are now in progress along that section of the coast.

This necessarily irregular and haphazard program is but one of the factors which serve to retard the charting of Alaska. The prime obstacle to rapid work is the weather. Spreading out as it does over so many degrees of latitude and longitude, it has many differing climates; but in all sections bad weather is the rule and a clear atmosphere the exception. The low fogs bring all operations to a standstill, but the peculiar and most annoying feature of Alaska weather is the prevalence of high fogs, which may occur when all other surveying conditions are favorable. They hide from view the tops of the hills and mountains, needed in the triangulation and off-shore hydrography.

Field work along the coast during the winter is out of the question in all sections. From May to October is the extent of the season in southeastern Alaska. The period is shortened at both ends farther north and along the Aleutian chain of islands by early fall and late spring storms, and in the upper part of Bering Sea, still further shortened by the persistence of the ice floes, which may not disappear until July.

Up to the present time the results obtained are shown on nearly a hundred charts, the condensed and selected information derived from thousands of volumes of astronomical, magnetic, sounding, and tidal records, and hundreds of topographical sheets. One would say that by far the greater part of the coast-line of Alaska having an economic value had been surveyed, were it not for the teachings of the past, which show how vain are prophecies concerning the future of any particular part of this country of hidden wealth.

Coincident with the coast work the Survey has been engaged on the international boundary, which, owing to the peculiar shape of the territory, is 1,200 miles in length. In 1889 two parties were sent to the interior of the country to determine the intersection of the 141st meridian with the Yukon and Porcupine rivers—a hazardous undertaking at that time and full of hardships. In addition to the two years' boundary work, the leader of one expedition made a sledge journey to the Arctic Ocean, and the other a running survey of the great Yukon River.

Owing to the conflicting claims in regard to the boundary along southeastern Alaska, a large mass of data had to be collected in the field, digested, and arranged for presentation to the tribunal which finally adjusted the points in dispute. The work of locating the boundary is described by Mr Riggs on pages 593-608.

Photo by Arthur Spencer, U. S. Geological Survey

CASTLE MOUNTAIN AS SEEN FROM THE RIDGE BETWEEN GILAHINA CREEK AND LAKINA RIVER

THE MONARCHS OF ALASKA

By R. H. Sargent, U. S. Geological Survey

If "Seward's Folly" were justified in no other way than by the purchase of this territory as a preserve of scenic grandeur, our far-sighted Secretary of State would be wholly exonerated.

After a visit to southeastern Alaska, one author of note has written: "Combine all that is best in the beauties of the Hudson and the Rhine, of Lakes George and Killarney, of the Yosemite and all of Switzerland, and you have a slight conception of the beauties of this green archipelago." Much of all this grandeur is to be found in Alaska's mountains.

Because of the comparative inaccessibility, except at great cost and much expenditure of time, the mountain districts have been visited by only a favored few. But the accounts and descriptions of these, fortified by photographs of the regions, are such as to awaken a keen desire in all lovers of nature to see them for themselves.

The steamers running to Juneau and Skagway traverse a course which is yearly pronounced by hundreds who take this trip as the most scenic upon the globe. For a thousand miles the steamer winds its way through tortuous and narrow passages, the waters of which are as smooth as a mill pond, while snow-capped peaks, ice fields, waterfalls, and green slopes pass in panoramic view before the eye.

The Coast Range of British Columbia and southeastern Alaska is an irregular mass of mountains with no definite crest line. These mountains may be considered a general northern extension of the highlands which parallel the Pacific seaboard of the United States. Along the entire coast from Seattle to Skagway, the sculpturing and general physiographic features of these mountains are such as to make them of particular interest. The broad, smooth-sided, ice-carved valleys, which subsequently were filled with water, due to the sinking of the entire region, make a very irregular coast-line, marked by numberless fiords, many of which extend far inland.

An archipelago of numberless islands, the relief of which is nearly equal to that of the mainland, fringes this entire coast-line. The passages between these islands are deep, each being remarkably uniform throughout its entire length. The mountains of both the islands and mainland rise, bold and precipitous, from the water's edge to heights of from 5,000 to 10,000 feet.

GLACIAL SCULPTURING

Many of the side valleys exhibit to a marked degree that physiographic characteristic of glacial sculpturing—the hanging valley. Often is seen, some hundreds of feet above tidewater, the broad, symmetrically carved U-shaped shelf, which, colored by the evergreens, makes a wonderful frame about the picture formed in the background by the cold gray mountains, with their snow-capped peaks, and in the foreground the stream fed by the melting snow and glaciers of the main range, plunging, roaring, often cascading down the precipitous face of the mountains for hundreds of feet.

SALMON FISHERIES

As the steamer glides past the entrance of a fiord, one catches a glimpse of a group of white buildings nestled at the base of the mountains, where the mirror-like waters of the inlet meet the precipitous evergreen slopes. An exclamation of amazement at the beauty of the picture is well nigh irrepressible. These buildings are simply one group of which there are scores along the southern coast, making one of the greatest of Alaska's industries, the canning of salmon. There are approximately 200,000,000 cans of salmon sent from Alaska each season.

Photo by W. C. Mendenhall, U. S. Geological Survey

THE NORTHERN SLOPES OF MOUNT SANFORD (ELEVATION, 16,200 FEET), AS SEEN FROM THE BANKS OF COPPER RIVER, NEAR AHTELL CREEK

ROUTE THROUGH THE MOUNTAINS

Skagway, at the head of salt-water navigation of southeastern Alaska, is the southern terminus of the White Pass and Yukon Railroad, which is the connecting link between the Pacific Ocean and the Yukon River, the great artery of central Alaska. This railroad is one of the interesting engineering accomplishments of the age. Starting at tidewater, it follows the valley bottom of the Skagway River for about three miles, and then gradually climbs the precipitous sides, winding in and out of the smaller side valleys and canyons, frequently crossing them, until 13 miles in a direct line from the starting point it crosses the Coast Range at the White Pass, 2,888 feet above the sea. On the northern side the range slopes gently to the great interior plateau, thus making the grade of the road from the pass to Whitehorse, the northern terminus, very slight, the elevation of the latter place being 2,084 feet.

A trip to the westward from Skagway may take one either by Sitka or through Icy Strait and Cross Sound. If the former is taken, an opportunity is given for viewing Mount Edgecumbe, the only recognized volcano in southeastern Alaska. Situated as it is, just off the coast, its dome-shaped summit covered with snow, it adds much to the beauty of the surroundings of Sitka, which is one of the most picturesque spots on the globe.

If the more-frequented route through Cross Sound is taken, the progress of the steamer will undoubtedly be greatly hampered by winding its way through the waters thickly strewn with floating cakes of ice. These icebergs are supplied by the large glaciers in the vicinity; the Johns Hopkins, Muir, and Brady glaciers and many others, each being large ice-sheets covering hundreds of square miles, discharge into Glacier Bay, which opens to the Sound.

SAINT ELIAS MOUNTAINS

From Cross Sound westward the mountains increase in height and grandeur. The Fairweather Mountains rise abruptly from the ocean to heights of over 15,000 feet, while farther to the westward the range increases in elevation until, at Mount Saint Elias and Mount Logan, altitudes of 18,000 feet and 19,500 feet, respectively, are reached.

Mount Saint Elias, however, has figured in Alaskan exploration from the earliest accounts. In fact, it is the first point of the territory which was sighted by Bering in 1741. He discovered it on Saint Elias' day, and accordingly gave it the name. Singularly, it is a cornerstone of the International Boundary, since it lies practically in longitude 141° and is on the crest of the range. Here the boundary, which follows the 141st meridian, bends abruptly to the east, following the crest of the mountains.

Saint Elias, while not the highest in the group, has become the most widely known because of the numerous attempts to climb it. I. C. Russell, of the United States Geological Survey, made two attempts to reach the top. One of the expeditions of which he was the leader was financed by the National Geographic Society. His narrative of one of these expeditions was printed in the magazine in May, 1891. The harrowing experience is related of two days alone on the snow-clad sides of the mountain at an elevation of 14,000 feet, while a fierce blizzard raged and many feet of new snow were added to the old.

Russell was unsuccessful in his attempts to reach the summit, but his suggestions as to the advisable route in an ascent gave such accurate and valuable information to those who followed that the Duke of the Abruzzi, accompanied by guides, profiting by his advice, succeeded in reaching the summit in 1897.

While but 18,000 feet in height, Mount Saint Elias, as well as McKinley and many other Alaskan mountains, presents difficulties to the mountaineer not usually encountered. Unlike the majority of difficult peaks which have been conquered, where the first few thousand feet of altitude are traversed over roads or trails, the entire 18,000 feet demand ex-

treme exertion and present many obstacles to be overcome. The journey throughout its entire length being over glaciers, the unique problem of combining arctic exploration with mountain climbing is experienced.

GLACIERS AND SNOW FIELDS

The eastern part, especially the coastal slope of the Saint Elias and Fairweather ranges, is the only portion of Alaska which bears out the popular belief that the territory is covered with ice and snow. Here in the high mountains there are many Alpine glaciers and snow fields, but the Malaspina Glacier is the largest single ice field and, indeed, the most extensive on the North American continent. This great piedmont glacier spreads out over the coastal plain, presenting a front of 85 miles to the sea, and, including the névé fields which feed it, covers an area of 5,000 square miles.

This ice field is most vividly described by Russell,* who viewed it from the upper slopes of Mount Saint Elias, as "a vast, snow-covered region, limitless in expanse, through which hundreds and probably thousands of barren, angular peaks project. There was not a stream, not a lake, not a vestige of vegetation in sight. A more desolate or more utterly lifeless land one never beheld." The view of this ice field and the adjacent mountains as seen from the ocean is superb in the extreme.

This southern chain of mountains continues to the westward, where it is known as the Chugach Mountains, passing around the head of Prince William Sound and terminating in the Kenai Peninsula, where it forms little more than highlands. Just north of Prince William Sound the range is a mass of snow-clad peaks, in the valleys of which are hundreds of square miles of ice, almost entirely unexplored.

ALASKA'S HIGHEST VOLCANOES

About 150 miles to the northwest of Mount Saint Elias are the wonderfully impressive peaks of the Wrangell group, which owe their existence largely to vulcanism. There are many peaks in this group, but four, because of excessive altitude, grandeur, or activity, demand special attention.

Mount Sanford, the highest, reaches an elevation of 16,200 feet, while Blackburn is a close second at 16,140 feet. Both of these mountains are extinct volcanoes. Mount Wrangell is a great flat dome 14,000 feet high and about 25 miles in diameter at its base. It is the only active volcano of inland Alaska. Its summit is snow-covered, but surrounding the vent is a coating of ash renewed intermittently by rolling clouds of smoke and vapor which are sent up from the crater. Mount Drum, also a volcanic cone, but now deeply dissected, though but 12,000 feet high, is the most impressive one of the group. Situated as it is, well out in the Copper River plain, with nothing to detract from its grandeur, its isolation commands the observer's undivided attention.

Much of the Wrangell range is covered with ice and perennial snow, forming long, finger-like Alpine glaciers, which extend in every direction.

On the north, west, and south sides of the group the melting snow and ice of the glaciers form the tributaries of the Copper River, which flows southward through the Copper River basin, and breaks through the Chugach Mountains at about longitude 145°, for the most part in a narrow canyon. Though the Copper River in stretches is very swift and dangerous, it serves as a route of approach to the inland gold and copper fields. The canyons and rapids of the lower river, though serious obstacles to navigation, have not prevented the use of this route.

THE ADVENT OF RAILWAYS

The onward march of civilization and development, which has opened up our Western States so wonderfully, is steadily at work in Alaska. Already the screech of the locomotive has broken the silence of the mountain fastnesses, startling the mountain goats and sheep from their

*National Geographic Magazine, May, 1891.

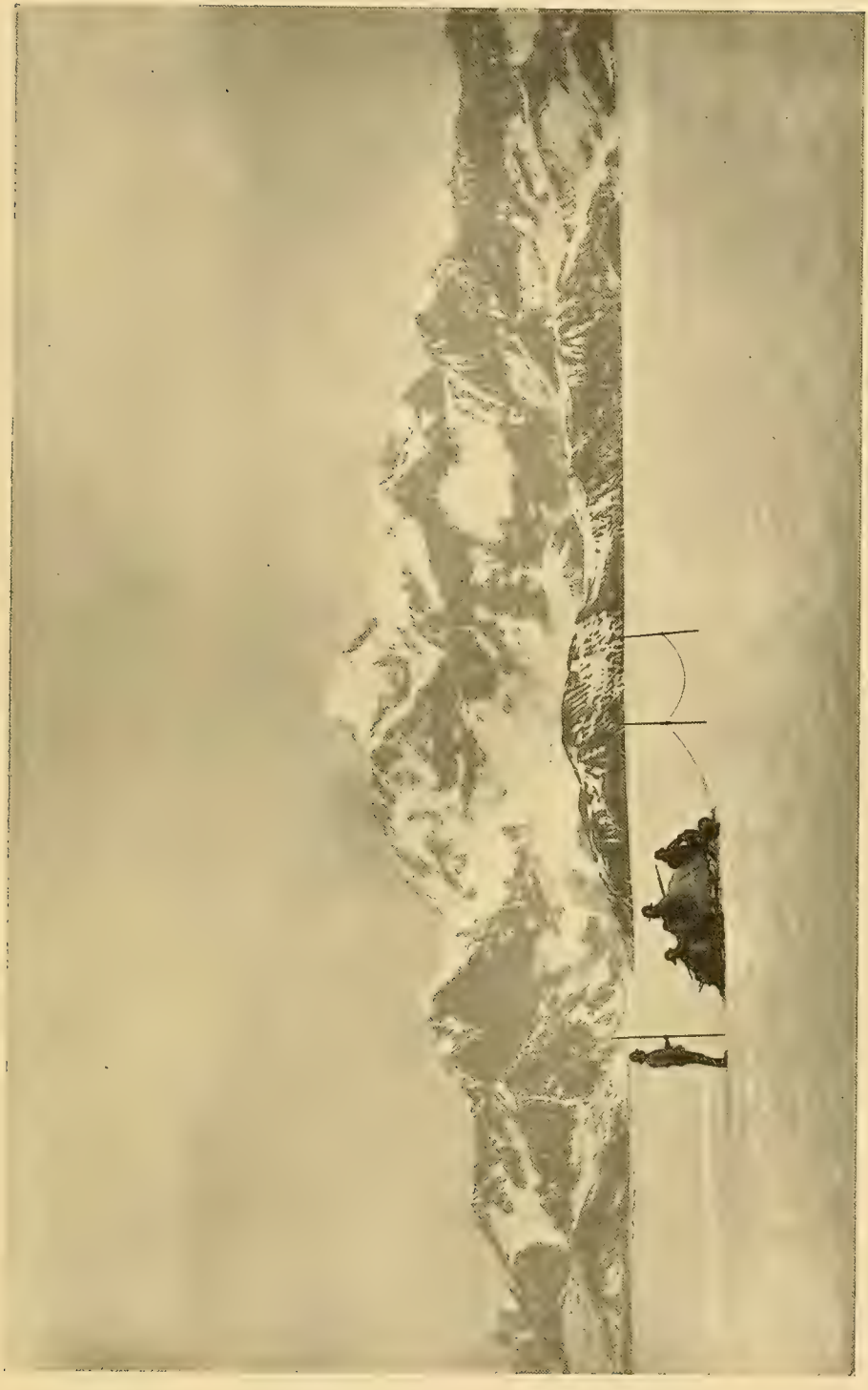


Photo by I. C. Russell, U. S. Geological Survey

MOUNT SAINT ELIAS HAS FIGURED IN ALASKAN EXPLORATIONS FROM THE EARLIEST ACCOUNTS

Photo by W. C. Mendenhall, U. S. Geological Survey

A VIEW INTO THE EASTERN PORTION OF THE ALASKA RANGE FROM THE FOOT OF GAKONA GLACIER

Photo by W. C. Mendenhall, U. S. Geological Survey

MOUNT DRUM, 12,000 FEET HIGH, FROM THE CREST OF THE RIDGE BETWEEN NADINA AND KLAWASINA RIVERS

Photo by W. C. Mendenhall, U. S. Geological Survey

SNIDER'S PEAK, RUGGED, ANGULAR, AND FORMIDABLE, OFTEN RESEMBLING CLUSTERS OF SPIRES

haunts among the jagged spurs along the canyons. The Copper River Railroad is being steadily advanced against the most difficult of engineering obstacles. It follows the valley of the river, crossing it twice to the present point of its construction, and another crossing will be made. If the present rate of progress continues, the road will soon reach the base of the Wrangell Mountains and thus make it possible to develop the copper deposits of that field. About two hundred miles to the west of the Copper River from Resurrection Bay northward through a low pass in the Kenai Mountains, the Alaska Central Railroad Company has commenced to build a line to the coal fields of the Matanuska Valley, and is contemplating an extension up the valley of the Susitna across a low pass in the Alaska Range to Fairbanks, on the Tanana River, and the center of a large placer district.

ALASKA'S HIGHEST MOUNTAIN

The Alaska Range stretches from a little-explored region in the vicinity of Lake Clark, west of Cook Inlet, northward for one hundred miles or more, then trends gradually eastward, increasing in altitude until in Mount McKinley it attains the remarkable height of 20,300 feet. It is broken by gaps 2,400 feet and 3,000 feet above sea-level at the head of the Yentna River, and by one at the head of the Susitna River, 1,500 feet above sea-level. The eastern end of the range rises again until at Mount Hayes an elevation of 13,800 feet is reached.

Words fail to express one's impression of the Alaska Range when viewed under favorable circumstances. In 1906, while making a trip through the Talkeetna Mountains, the writer had such an opportunity as is rarely experienced. His view was from an elevation of about 2,500 feet on the foothills on the western slope of the Talkeetna group. The day was perfect; not a cloud could be seen in the heavens. Below lay the broad, level valley of the Susitna River, beautifully carpeted in the deep green of the coniferæ, while here and there a shining patch of light, outlining a lake, broke the monotony, and through the center of it all the Susitna wound like a silver trail.

Across the valley, 50 miles away, the foothills of the Alaska Range rose, rugged, angular, and formidable, their cold, gray, serrated peaks often resembling clusters of spires; while back of them, dwarfing to the height of mere foothills in comparison, Mount Dall, Mount Russell, and Mount Foraker stood like white-clad guardians to their chief, Mount McKinley, towering grand, superb, indescribable, 20,300 feet above the sea. A sweep of the horizon from the south to the northeast, where the view was cut off by the adjacent mountains, gave the grandest panorama imaginable. Far away in the distance could be seen the volcanoes Iliamna and Redoubt, on the western shore of Cook Inlet, while at the other extremity Mount Hayes towered high above everything about it. Between these two extremes the waving crest-line of the range was now painted in the green of a river valley, now cold, steel gray, as it outlined the lower peaks, gradually becoming whitened as it reached its crest, and then on through the same transition until lost to view—a memory which can never be taken from me.

Under favorable conditions, Mount McKinley can be seen for a distance of 150 miles, a huge sugar-loaf mass, towering high above everything about it. To the Russians it was known as "Bulshaia," while the natives of Cook Inlet called it "Traleika," both meaning "big mountain." The present name was given it by W. A. Dickey, who in 1897 ascended the Susitna River for a short distance, and was the first to call attention to the great height and the location of this magnificent peak. He made a bold guess at its altitude, which was confirmed three years later by Robert Muldrow, of the United States Geological Survey.

Just south of McKinley is Mouth Disston, a triple peak, following it a close second in height. Farther south along the range are Mount Foraker, 17,000 feet, Mount Russell, 11,300 feet, and

Photo by W. C. Mendenhall, U. S. Geological Survey

MOUNT WRANGELL: INTERMITTENTLY ROLLING CLOUDS OF SMOKE AND VAPOR ARE SENT UP

Photo by W. C. Mendenhall, U. S. Geological Survey

MOUNT DRUM: ITS ISOLATION DEMANDS THE OBSERVER'S UNDIVIDED ATTENTION

MOUNT MCKINLEY, ALASKA'S HIGHEST MOUNTAIN (SEE PAGE 619) Photo by Judge James Wickersham

Mount Dall, 9,000 feet; while farther yet to the south, across the valley of the Skwentna, is Mount Spurr, 10,500 feet high.

Above 9,000 feet the mountains are perpetually covered with snow and ice, and at their bases, on either side of the range, long tongues of ice shoot out, filling the valleys in the neighborhood of Mount McKinley in some instances for a distance of 25 miles.

Nothing was known of the region adjacent to Mount McKinley until in 1902 Alfred H. Brooks, accompanied by L. M. Prindle and D. L. Reaburn, all of the United States Geological Survey, were the first white men to reach its western slope. In 1906 Dr Cook succeeded in reaching the top, making the ascent from the east. Mount McKinley is the only one of the many snow-covered peaks of the Alaska Range which has been climbed. Indeed, even of the immediate locality of the others very little is known.

THE COASTAL VOLCANOES

The chain of volcanoes, active and extinct, which follows the Pacific coast from Cape Horn, north through South America, Mexico, the United States, and Canada, has it representatives along the Pacific coast of Alaska also, even to the extremity of the Aleutian Islands. Mention has already been made of Mount Edgecumbe, in southeastern Alaska, and those of the Copper River region.

The largest zone of volcanic activity in Alaska is from the west shore of Cook Inlet, at Redoubt Mountain, southwestward throughout the entire length of the Aleutian range. Practically the entire range is composed of volcanic ejecta. There are many beautifully shaped cones of extinct craters, while a few are active at the present time. Among these Iliamna and Saint Augustine are in the northern portion of the range, the latter being located on the island of the same name. On Unimak Island, the first of the Aleutian group, there are two active craters, Sishaldin and Pogromi, and on Unalaska Island, 100 miles to the southwest, is Makushin.

The mountains of the Aleutian Islands are not so high as those of the mainland, Sishaldin being about 8,000 feet, while Makushin is not over 4,500 feet.

About 50 miles to the west of the north end of Unalaska Island, in latitude 54° and longitude 168°, lies the magic crater Bogoslof. Though insignificant in size, in comparison with the less active craters of the group, it is not lacking in interest. So rapid are the diastropic and volcanic metamorphoses of Bogoslof that it was at one time a volcanic cone 450 feet in height, with an island of 2 square miles at its base, and 10 days later a subsidence had taken place, until scarcely more than 40 feet relief remained and the island was reduced to a few acres. The fluctuations between elevation and subsidence are so frequent and radical that it is never safe to announce its condition at any stated time.

The facilities for travel by trails, wagon roads, steamers, and railroads are steadily increasing, and within a very few years many of the now comparatively inaccessible regions will be easily reached. Such a condition will not only open to the general public a region unsurpassed in scenic grandeur, with many opportunities for the professional mountaineer, but will be instrumental in advancing the territory's commerce, mining, and agriculture.

THE BIG GAME OF ALASKA *

By Wilfred H. Osgood, of the U. S. Biological Survey

ALASKA is not, like Africa, a country where great herds of game of many kinds are seen even by the passing traveler; yet in its various parts our northern possession is the home of many important game animals, including some which are the largest and finest of their kinds.

Owing to the diverse topography and range of climatic conditions within the territory, the game is not uniformly distributed; indeed, there are many large areas in which game of any kind is exceedingly scarce, and doubtless this was true even before the days of the gold-hunters. But within its chosen haunts each of the various game animals is abundant. In the extensive forests of the interior the giant moose stalks about in silent majesty, while on the surrounding peaks of the highest mountains of North America the agile mountain sheep follows its roughly beaten trails over the pinnacles.

On the bleak tundras of the Arctic coast, as well as on the treeless mountain slopes farther south, herds of caribou rove in countless numbers. Even among the ice floes of the frigid Arctic one may encounter the great polar bear and the huge, awkward walrus. In contrast to these is the graceful little Sitka deer, an animal of southern affinities, which threads its maze of trails in the luxuriant vegetation of the southeastern coast district. To this attractive picture for the big-game hunter is still to be added the grizzly and black bears and the great fish-eating brown bears of the Alaska Peninsula.

But Alaska's game is scarcely of more interest to sportsmen than to the pioneers who live their lives in the great northern territory and greatly appreciate a fare of juicy moose or caribou meat instead of salt pork. Fortunately both sportsmen and Alaskan residents are becoming awakened to the need of husbanding their stock of wild game instead of sacrificing it to immediate desires. Laws are difficult to enforce in a frontier country and the safety of game lies largely in the fostering of good public sentiment. Alaska can no more afford to waste its game than its fish, forests, or minerals.

In the United States and the Canadian provinces a tardy appreciation of the value of game and an apprehensive realization of its impending extinction are causing the enactment of many stringent laws, while not a few sanctuaries or game refuges are being set apart. In many cases the game is disappearing, not because of unrestricted killing, but on account of a reduced food supply, the winter range of the animals having been occupied for agricultural purposes. Notwithstanding the rapid economic development of the territory, it is unlikely that such conditions will ever exist in Alaska, and the necessity of restocking the natural preserves there need never arise if suitable preventive measures are taken before it is too late. The range for game in Alaska will remain indefinitely; our obligation is only that of saving the animals themselves.

Taking up the game animals of Alaska individually, we may begin with the largest, the moose.

THE ALASKAN MOOSE IS THE BIGGEST MOOSE KNOWN

Both the well-known moose of eastern North America and its relative, the elk of the Old World, are surpassed in average size by the Alaskan animal, which zoölogists distinguish as a separate variety (*Alce americanus gigas*). Its antlers are particularly large, having an average spread of from 5 to 6 feet, and in no small number of recorded instances even exceeding 6 feet. Moose are generally distributed throughout the forested parts

* Several of the author's photographs illustrating this article were taken on the Canadian side of the line in the Yukon Territory, but the scenes and animals are characteristically Alaskan.

Photo from U. S. Biological Survey

THE ALASKA MOOSE (ALCE AMERICANUS GIGAS)

A MOOSE WHICH FELL CONVENIENTLY ON THE BANK OF A TRIBUTARY OF THE YUKON

of Alaska, except in the coast district south of Cook Inlet, where they are wanting. On the Alaska Peninsula they range to the limit of timber, and in the north and west likewise reach the edge of the tundra. Although spending most of their time in mixed woods of spruce, poplar, and birch, at moderate elevations, they frequently ascend to open mountain ridges above the timber.

Once while following a sheep trail among the almost inaccessible pinnacles of Glacier Mountain west of Eagle, Alaska, I was greatly surprised to find signs of moose. Although knowing that moose often range above timber, not only under stress of circumstances, but also through choice, I scarcely expected to find them in these barren, jagged rocks, through which a man could travel only with great difficulty. Proceeding for about half a mile, during which the country became more and more rugged, I soon found the trail strewn with bones and came finally to a large skull, nearly perfect, and bearing the antlers of a large old bull moose. Just how the big fellow met his death can scarcely be known, but little imagination is required to produce a thrilling tale of tragedy. Signs of wolves were found near by, but that they were contemporaneous with the bones could not be ascertained. The pinnacles of Glacier Mountain are the highest in the entire region, and from the spot where the bones lay one can look across billows of mountains down to the shining Yukon and on beyond to the high peaks of the Ogilvie Range. What a setting for a mortal combat, if such there was!

Sportsmen hunting moose in Alaska usually follow the method known as still hunting, while the meat hunters, like the Indians, frequently practice the lazy but effective plan of lying in wait near trails, ponds, licks, or other places to which the animals regularly resort. But calling with the birch-bark horn, as practiced in eastern Canada, is seldom attempted, and

A VERY LARGE BULL CARIBOU KILLED ON THE FLAT TOP OF A HIGH MOUNTAIN

perhaps on this account the statement is often seen that the Alaska moose will not respond to calling. That it does do so I am amply convinced by an experience in the Yukon Territory while hunting with Mr Carl Rungius the well-known painter of big game.

One September evening in a good moose country we took a position on a slight elevation overlooking a sparsely wooded flat and began calling. Mr Rungius, who had had experience in New Brunswick, handled the trumpet. After the fourth call a faint rattle of horns was heard in the distance, perhaps half a mile away. Another call and the horns rattled again, this time a little nearer, and soon no doubt remained that a bull moose was coming directly toward us. No animal but a moose could make such a noise. For a time all would be deathly still, and then, crash! as the horns rattled their challenge against the resonant branches of a dead tree. Not long after a second animal was heard coming from another direction, and eventually the ghostly form of a very large moose carrying massive antlers stalked in full view across an opening in the trees some 300 yards away; at the same time another, perhaps younger and smaller, was coughing and grunting in a thick clump of trees not 50 yards from us.

CARIBOU

The caribou of Alaska consist of several varieties closely related to or identical with the barren-ground caribou (*Rangifer arcticus*) of north central Canada. They inhabit the treeless mountain ridges of the interior and the rolling tundras of the coast from the Arctic Ocean to the Pacific side of the Alaska Peninsula, feeding almost exclusively on the delicate greenish white lichen called reindeer moss, which grows abundantly throughout the region.

Owing to their highly gregarious habits and their general stupidity, the caribou are likely to be among the first of Alaska's game animals to be extirpated. In spite of the open nature of their habitat, they are not sharp-sighted, but depend almost entirely upon scent

Photo from F. H. Moffit, U. S. Geological Survey

SMALL BAND OF DALL'S SHEEP NEAR THE HEAD OF THE NABESNA, A TRIBUTARY OF THE COPPER RIVER

for protection. In the mountains between the Yukon and Tanana rivers, where I once enjoyed the privilege of seeing several hundred caribou within a few days, I repeatedly put this to the test and was amazed to find such helpless and naturally timid animals so lacking in powers of observation. While I sat or stood within full view they came down the wind directly toward me without the slightest sign of alarm until within a few rods. Several times small herds passed within 50 yards utterly oblivious to danger until reaching a position where the wind blew from me to them, when they immediately became terror-stricken. Curiosity also is one of their failings, and it may readily be believed, as often stated, that a man on horseback, by taking a prominent position on an open hilltop, will attract any caribou that may be in the vicinity. More than once while skinning a dead caribou I have been interested to see several of its one-time comrades circling about, coming again and again within 50 yards to stand and watch for a moment and then dash wildly away.

It has never been my good fortune to see more than 40 or 50 caribou at one time, and although such enormous herds as are reported on the Canadian Barren Grounds have never been seen in Alaska, there is much reliable evidence that herds numbering several thousand animals are still to be seen there.

MOUNTAIN SHEEP

The well-known bighorn or Rocky Mountain sheep, formerly so common in Colorado, Montana, and other Western States, does not extend to Alaska, but is represented there by another species (*Ovis dalli*) of slightly smaller size, more slender horns, and pure white color. Like other mountain sheep, this species spends most of its life above timberline, even remaining among the heights during the severe northern winter. This is perhaps not such a hardship as might be supposed, for the irregularities of the cliffs and gorges often afford more op-

portunities for shelter and exposed food supply than might be found on the more level ground of the lowlands. In summer the sheep feed mostly on the open slopes, luxuriant with low, matted vegetation, and in the beautiful saucer-like basins lying just below the ultimate heights. Unlike the caribou, they are very keen of vision and depend little upon scent for warning of danger. As a test of this I once sat in a concealed position above a small band of them and lit my pipe and watched the smoke drift toward them on the light breeze. They gave no sign of alarm, but continued feeding until I showed myself, when they precipitately took to flight.

The white color of these sheep, as might be supposed, often makes them quite conspicuous. They frequently lie for hours in the warm sun on smooth, green hillsides, where they are readily seen from all points for miles around. However, their coat in summer is always decidedly brownish from earth stain, and one may easily overlook a large flock of them when they are on a hillside of light brownish limestone such as is characteristic of several localities in which I have found them. In winter, the color of the long, thick coat is snowy white and may afford them considerable protection from enemies, though just why other mountain sheep having practically identical surroundings are not also white is a mystery.

The white sheep formerly ranged over practically all the mountains of the interior of Alaska, and at present it is absent only from those mountains which lie near permanent settlements. It is abundant near the coast on the Kenai Peninsula and on the Arctic slope north of the Endicott Mountains, but elsewhere it is strictly confined to the peaks and ranges of the interior.

MOUNTAIN GOAT

A still more hardy mountaineer than the sheep is the white goat (*Oreamnos*) which inhabits the coastal mountains of Alaska from the Canadian boundary at Portland Canal northwest to the vicinity of Cook Inlet. Besides including the great glaciers, this region is one of extremely rugged mountains throughout, and though the scenery is magnificent, the climate, at least from the human standpoint, is not always all that could be desired. But the goats seem to prefer it to the sunnier ranges of the interior, to which they seldom stray. They live almost entirely at high altitudes, frequenting very steep cliffs and rock-walled canyons, and if a glacier affords passage from one part of their range to another, they unhesitatingly make it their highway.

To approach a mountain goat successfully is therefore quite as much a feat of mountaineering as of crafty hunting. In fact, it is more so, for the goat is rather stupid and keeps watch only over the country below him, so it is necessary to get above—and to get above a white goat is usually to attain the uttermost heights. But the lusty hunter who does so has few regrets, for the magnificent scenery is ample recompense for the physical exertion. Hunting the chamois in the Alps, now practically a thing of the past, scarcely could have offered such scenic surroundings as may now be had in the pursuit of the mountain goat in Alaska.

The flesh of the mountain goat, except in young animals, is strong and not especially palatable, while its hide has little commercial value. The additional fact that the animal cannot be obtained by lazy methods makes it very improbable that it will be extirpated in the near future. It has short, strong legs, a short neck and a thick, heavy body, withal presenting a clumsy appearance quite the reverse of what might be expected from the precarious nature of its habitat. The horns, which range 7 to 10 inches in length, are small, recurved, polished, and blackish. They are present in both sexes.

Many an old-timer in Alaska will tell the visitor that a species of ibex different from both sheep and goat inhabits the territory. When such stories are sincere they undoubtedly refer to young goats or to either the young or the female of the white sheep, for no true ibex is native to any part of North America.

DEER

In the north caribou are commonly called "deer," but there are no true American deer (*Odocoileus*) in Alaska except in the southeastern coast district from the vicinity of Sitka southward. Only one variety occurs, but this is exceedingly abundant, although the region inhabited by it lies well beyond the northern limits of any other American deer. It is a variety of the Columbia blacktail, from which it differs chiefly in smaller size and in having the upper side of the tail more extensively brownish. In size it is small, ordinary bucks weighing rather less than 100 pounds. It ranges from seacoast to timber-line in a region of forests and undergrowth rivaling those of the tropics in density and luxuriance.

One scarcely steps away from the beach within this region without encountering deer trails, and if one undertakes to follow any of them he is led through a veritable maze, now bending low to escape the wicked thorns of the "devil's club," now pushing through the yielding twigs of huckleberry bushes, again struggling among a tangle of the heavy-foliaged and matted sallal, or tolled on to future difficulties by the quick and easy progress afforded as the course leads along a hoof-worn furrow in the fallen trunk of a giant cedar. Under such circumstances, one knowing the general cunning of deer might suppose they would be very difficult to sight, but they occur in such abundance that in spite of much killing in the past they still may be found with no great effort. Until quite recently they were killed by thousands merely for their hides, which netted the hunter a few cents apiece.

But the present game law and rapidly improving local sentiment now promise to save them for the profit and enjoyment of future generations.

A BUSY DAY IN CAMP SKETCHING AND PREPARING MOOSE HEADS

BEARS

It is probably quite safe to say that Alaska is the home of more different kinds of bears than any other country of equal size in the world. No fewer than 13 kinds, as recognized by recent mammalogists, live in the Territory. The distinctions among some of these are based largely upon osteological characters apparent only to specialists, so to the ordinary observer the bears of Alaska resolve themselves into four groups—the brown bears, the grizzlies, the black bears, and the polar bears. Even this classification cannot be followed with certainty by amateurs, for although the extreme types are sufficiently distinct, some of the smaller varieties of the brown bears are easily confused with some of the larger ones of the grizzlies.*

The brown bears, typified by the huge species (*Ursus middendorffi*) of Kadiak Island, are the most interesting of Alaska's bears. They are of immense size, greatly exceeding the Rocky Mountain grizzlies and all other bears except the polar bear and their own relatives of the Siberian coast. Even the extinct cave bear is by no means a giant in comparison with them. They are confined almost exclusively to the coast region, ranging from Bering Sea throughout the Alaska Peninsula and some outlying islands, and thence south along the Pacific coast to the Alexander Archipelago. Their color varies greatly, ranging from dark seal brown to buffy brown, but although the ends of the hairs are often paler than the bases, the silver-tipped effect of the grizzlies is wanting.

NATURALIST RETURNING WITH ELEVEN CARIBOU SKULLS AND HORNS FOR AMERICAN MUSEUMS: GLACIER MOUNTAIN, NEAR EAGLE, ALASKA

* The confusion in the classification of the Alaska bears is due in part to lack of sufficient material for careful study. Hunters and residents of Alaska would confer a favor upon all naturalists and sportsmen if they would preserve bear skulls and send them to some large museum, preferably to the U. S. Biological Survey at Washington, which has, deposited in the U. S. National Museum, the finest collection of large bear skulls in the world.

Photo by C. Hart Merriam. From "The Harriman Alaska Expedition"

FUR-SEALS: SAINT PAUL ISLAND, BERING SEA (SEE PAGE 587)

Photo by C. Hart Merriam. From "The Harriman Alaska Expedition."

HAREM OF FUR-SEALS: PRIBILOF ISLANDS, BERING SEA

Painting by Charles B. Hudson. Photo by C. Hart Merriam. From "The Harriman Alaska Expedition"

SEA-LIONS: PRIBILOF ISLANDS, BERING SEA

From a painting by Charles R. Knight. From "The Harriman Alaska Expedition"

KADIAK BEAR, URSUS MIDDENDORFI MERRIAM: KADIAK ISLAND, ALASKA

The front claws are thicker, shorter, and more abruptly curved than in grizzlies.

Owing to their great size, the brown bears are doubtless more powerful than the grizzlies, but they have the reputation of being more peaceable. As a rule, like other wild animals, they give man a wide berth, but in close quarters or under unusual circumstances they have been known to seriously injure or kill human beings. Like most other bears, these huge beasts avail themselves of everything the country affords in the way of food, including fish, flesh, fruit, roots, and grass—a variety of diet scarcely exceeded by that of the natives when under aboriginal conditions. On coming out from hibernation in the spring they eat young grass, herbage, and roots, and, if near the coast, a little kelp. Later they capture mice and ground squirrels, and when midsummer and the salmon come they make fishing their chief business. In the fall they fatten on berries.

The brown bears of Alaska will doubtless become very rare or extinct at no very distant date. Already they have become scarce on Kadiak Island, where formerly very abundant, and on the Alaska Peninsula, though still fairly numerous, they are being killed at a rate probably greatly in excess of their increase.

The grizzly bears of Alaska belong to at least two varieties, one (*Ursus horribilis phæonyx*) of the interior, the other (*Ursus kenaiensis*) of the Kenai Peninsula and adjacent coast region. Their habits are similar to those of the well-known grizzlies formerly so common in the western United States. In summer they are frequently found above and near timber-line, but they roam widely. At present they are perhaps most numerous in the Endicott Mountains and the Nutzotin and Alaskan Mountains, including the region of Mount McKinley.

Black bears are fairly common throughout all Alaska south and east of the treeless tundra. They are among the shyest of animals, and many doubtless slip away without allowing themselves to be seen. Thus in many districts where fairly common they are supposed to be scarce. The cinnamon variety is common in the interior, but rare or almost unknown on the coast.

Belonging with the black-bear group is the rare and interesting glacier bear (*Ursus emmonsi*), inhabiting the southern slopes of the Saint Elias Range and near-by mountains, at least from Cross Sound to the vicinity of Cape Saint Elias. It is supposed to live near the numerous glaciers of this region, but its habits are practically unknown and scarcely a dozen specimens, mostly imperfect, are contained in the museums of the world. The glacier bear is similar in size and general characters to the black bear, differing mainly in its color, which is silvery gray slightly mixed with black, the nose being brown and the feet blackish. In certain conditions of pelage the color has a somewhat slaty or bluish gray effect, from which the animal is sometimes called the "blue bear."

The well-known polar bear, which is no less common near the northern coast of Alaska than elsewhere in similar latitudes, completes the list of Alaska's bears. Owing to the remoteness of its habitat, it is seldom seen except by whaling or exploring parties. Almost emblematic of the territory under the false ideas at one time prevailing, this bear is now, in any consideration of Alaska's large animals, the one least to be thought of as characteristic of the country.

SOME GIANT FISHES OF THE SEAS

By Hugh M. Smith

U. S. Deputy Commissioner of Fisheries

BELIEF in the existence of sea serpents and other marine monsters goes back to a very remote antiquity and may be as old as man himself. That great Hebrew poem which we call the Book of Job has much to say about the "leviathan." This creature has been the subject of much speculation and may have been a myth, but there is nothing inherently improbable in its being a giant fish, and the following scriptural account might well have been written yesterday instead of three thousand years ago:

Canst thou draw out leviathan with a fish-hook?
Or press down his tongue with a cord?
Canst thou put a rope into his nose?
Or pierce his jaw through with a hook?
Shall the bands of fishermen make traffic of him?
Shall they part him among the merchants?
Canst thou fill his skin with barbed irons,
Or his head with fish-spears?
Lay thy hand upon him:
Remember the battle, and do so no more.

Who knows that primitive man may not have been coeval with some formidable marine creatures now extinct, the tradition of which has come down through the ages and left its impress on the mind of the present generation? The avidity and credulity with which the general public year after year receives newspaper accounts, which are purely fictitious or hang on slender threads of fact, portraying the capture or sighting of creatures of impossible form, show how firmly established and deep-seated is the conviction that the sea contains leviathans not yet known to science. Every season yields a fresh crop of sea-serpent stories and a new series of grotesque pictures of creatures which, if they really existed, would revolutionize our ideas of the animal kingdom. The writer has personally followed to their lairs two or three of the most horrible monsters conceived by the vivid imagination of the newspaper man, and found them to be well-known animals with little to suggest the sea serpent.

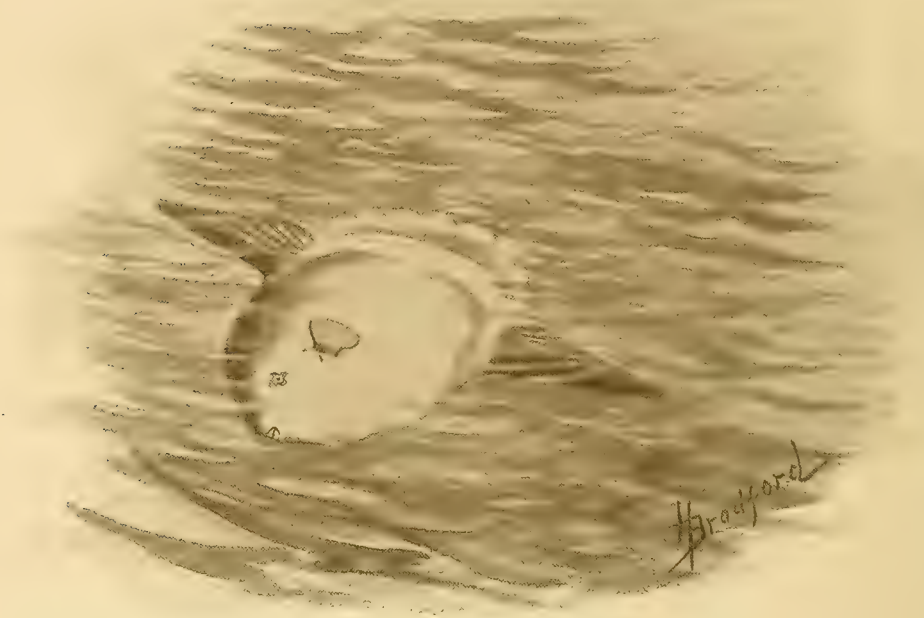
As to whether there really exist in the sea today strange monsters, scientists are not wholly in accord, although a negative view is held by most of them. The very circumstantial account of the sighting of a "sea serpent" on the Asiatic coast by the French gunboat *Decidée* a few years ago, as published in the journals at the time, will perhaps weaken the belief of some intelligent persons who have heretofore denied the possibility of the existence at this day of marine monsters comparable to those of geological times.

Whatever may be the truth as to the existence of such creatures, there are well-known members of the fish class which are so large that they deserve to be regarded as monsters, and may be the basis of some of the sea-serpent yarns with which the world has been regaled for centuries.

Among the serpentiform fishes there is none of such exceptionally large size as properly to belong in the sea-serpent class, although some deserve to be considered as giants among eels. If any known fishes may be suspected of aspiring to be sea serpents, surely they are the morays, although a sea serpent only 30 feet long would hardly satisfy present-day requirements, and no morays have yet been recorded which were half so long. They have, however, been known to exceed 10 feet in length, and they are among the most dreaded of fishes, having formidable teeth and showing a disposition to attack men.

THE SUN-FISH

A fish of such peculiar form that the Italians call it *mola*, a millstone, and the Spaniards *pez luna*, moon-fish, is known to Americans and English as the sun-fish,



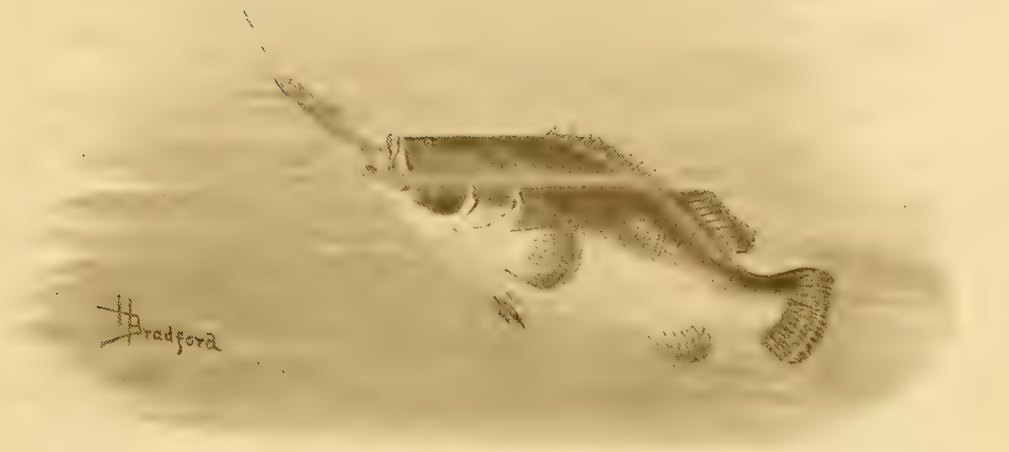
CHARACTERISTIC POSE OF AN OCEAN SUN-FISH

for it appears at the surface of the ocean on bright days and spends many hours basking listlessly in the sun, sometimes lying flat with one side just out of the water, sometimes with the back fin projecting like a buoy above the surface. It is disk-shaped, its height nearly equaling its length, and it has a long, narrow fin on its upper and lower edges posteriorly, and a short, broad flap representing the caudal fin; its eyes are large and its mouth small, and taken altogether it is one of the most grotesque of fishes, being apparently all head. Of almost world-wide distribution, it is particularly abundant on the southeastern coast of the United States and on the California coast. It swims but little, being usually content to be drifted along by the ocean currents. The Gulf Stream wafts many a sun-fish northward each summer, so that the species is not a rarity off southern New England, and I have seen a number of specimens that had become stranded on the coast of Norway. The fish is entirely harmless, and is so sluggish and listless, and is such a conspicuous object at sea, that it is easily approached and harpooned.

That the sun-fish deserves a place in the list of giant fishes may be judged from the fact that examples weighing 200 to 500 pounds are not rare, and that much larger ones are occasionally met with. The largest known specimen, harpooned in 1893 at Redondo Beach, California, weighed 1,800 pounds. On such a monster, lying on one side, there would be room for 30 men to stand. The strong teeth, shaped like a turtle's beak, suggest that hard-shelled animals constitute its food, but as far as known jellyfish are its chief diet. The extremely tough, fibrous skin, several inches thick, and the general coarseness of structure seem inconsistent with such delicate food.

TUNNIES AND JEW-FISHES

The valuable mackerel family has one member which easily ranks first in size



A JEW-FISH ABOUT TO SEIZE A BAITED HOOK

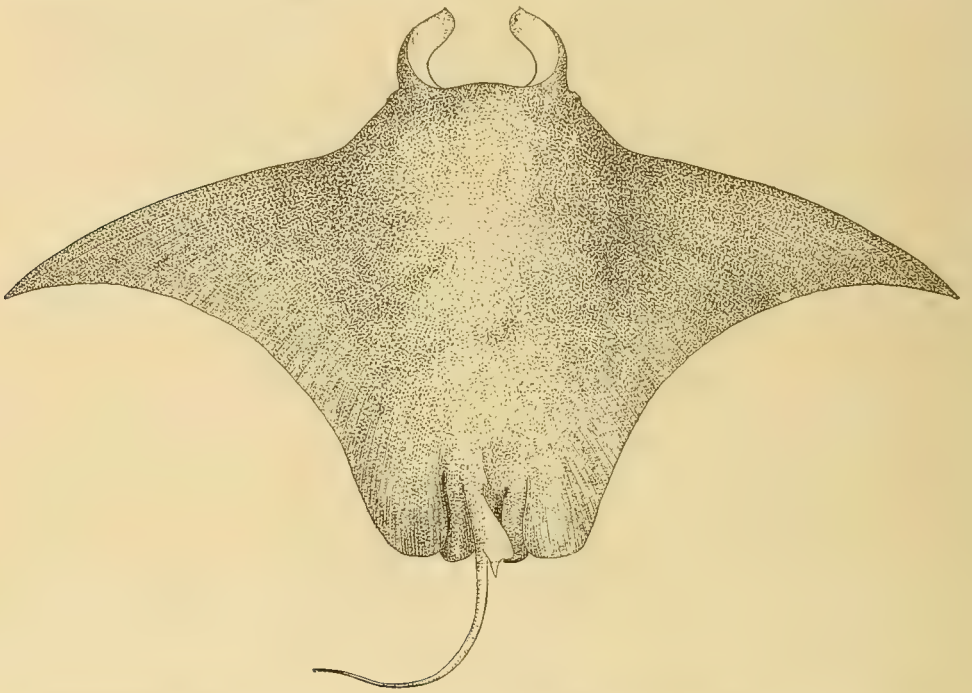
among the bony fishes, as distinguished from the sharks, rays, sturgeons, etc., with gristly skeletons. This is the horse mackerel or great tunny (*Thunnus thynnus*), whose range encircles the globe and which is an object of fisheries in many countries, notably southern Europe. Built on the compact and graceful lines of our common mackerel, it is the apothesis of speed, alertness, and vigor among the fishes of the high seas, and might very easily make a transoceanic trip in one-third the time of our fastest steamships. It preys on all kinds of small fish, and is often seen playing havoc among schools of luckless herring and menhaden. Fifteen feet is about its maximum length and 1,500 pounds its estimated maximum weight, although it is likely that this weight is considerably exceeded. Thirty tunnies harpooned by one fisherman during a single season weighed upwards of 30,000 pounds. A mutilated specimen 10 feet long was once found by the writer on the coast of southern Massachusetts; its head weighed 282 pounds and its carcass must have weighed fully 1,200 pounds when whole. In southern California, where this fish bears the Italian name of *tuna,* it is much sought by anglers, who use a 7 or 8 foot split bamboo rod and 600 or 700 feet of line baited with a flying-fish, and who have magnificent sport in landing small specimens weighing from 100 pounds upward, the record fish weighing 251 pounds and requiring four hours to kill.

Three species of fishes of the sea-bass family known as jew-fishes rank among the largest of the spiny-finned fishes. They inhabit tropical American waters, and range as far north as the California and South Atlantic coasts. The spotted jew-fish (*Promicrops itaiara*) is common in the West Indies, and reaches a weight of 600 pounds. The black jew-fish (*Garrupa nigrita*), found from South Carolina to Brazil, weighs 500 pounds. The California jew-fish (*Stereolepis gigas*), usually called sea bass, sometimes attains a weight of 600 pounds, and is one of the really great game fishes of the country, being much sought by anglers in southern California. An experienced angler has written, "My largest fish weighed 276 pounds, and I was repeatedly almost jerked overboard by the struggles of the bass. I have seen a 200-pound fish snap the largest shark line like a thread, and large specimens straighten out an iron shark hook; yet the skilled wielders of the rod catch these giants of the tribe

with a line that is not much larger than some eye-glass cords."

GIGANTIC "DEVIL-FISH"

Among the rays are several members which reach colossal proportions. The largest and best known of these is the so-called "devil-fish" (*Manta vampyrus*) of our South Atlantic coast and the tropical waters of America, which occasionally strays as far as Cape May and is

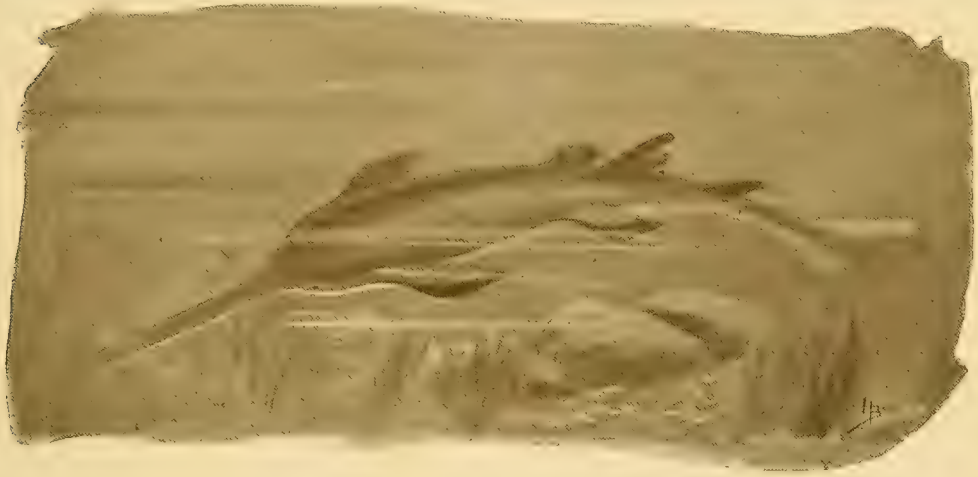


A DEVIL-FISH: SPECIMENS OF THIS FISH WEIGHING TWO TONS AND MORE HAVE BEEN CAUGHT

common south of Cape Hatteras. It is shaped like a butterfly or bat, and has been called the "ocean vampire." Projecting from either side of the head is a horn-like appendage, which in reality is a detached part of the pectoral fin or "wing." These horns, to which the name "devil-fish" owes its origin, are sometimes 3 feet long and are freely movable, being used for bringing food to the mouth. The mouth is peculiar in having no teeth in the upper jaw, while the lower jaw has about a hundred rows of small, paved teeth. Many years ago the pursuit of this fish was a favorite pastime of the Carolina planters, and William Elliott, in his "Carolina Sports by Land and Water," said: "Imagine a monster from 16 to 20 feet across the back, full 3 feet in depth, possessed of powerful yet flexible flaps or wings with which he drives himself furiously in the water or vaults high in the air." There are well-authenticated instances of this fish entangling its horns in the anchor ropes or chains of small vessels and towing them rapidly for long distances, to the mystification of the people on board. The pearl divers of the Caribbean Sea greatly dread this fish, and call it *manta*, meaning blanket, in the belief that it devours people after enveloping them in its enormous wings. The "devil-fish" is often seen lying quietly at the surface or slowly flapping its wings; at such times it is

easy to approach and harpoon it. It is only when attacked that the fish is dangerous, and then only by demolishing or overturning boats in its struggles.

The expanse of body in this species is greater than in any other known animal. Examples 16 feet wide are common, and those 20 feet across and over 4 feet thick are not rare. The maximum width is stated by authors to be 25 or 30 feet. One specimen, of which the writer had a photograph, caught in Lapaz Bay, Mexico, many years ago by the crew of the U. S. S. *Narragansett*, of which George Dewey was captain, was 17 feet wide and



SAW-FISH OF THE SOUTHERN LAGOONS

weighed nearly two tons. A fish of the largest size mentioned would weigh not less than six tons.

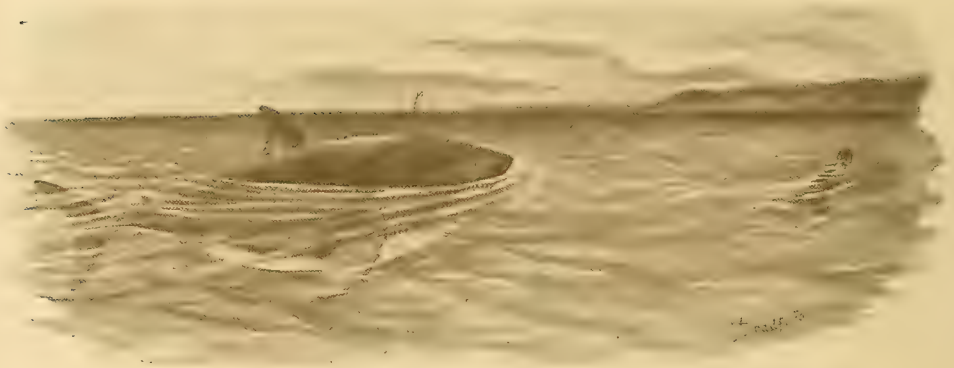
THE SAW-FISH

In the lagoons, sounds, and bayous of the West Indies and our southern coast there exists an abundant fish of great length, intermediate in structure between the sharks and the rays, and at once recognizable by the elongation of its snout into a wide, flat blade, in the edges of which are large, sharp teeth fitting in sockets and directed horizontally. The teeth are in 25 to 30 pairs, separated by wide intervals, and give to the saw-fish its name. The species is well known to those who reside in or visit the South Atlantic and Gulf seaboards, and the "saws" are familiar objects in curio stores all over the country. This fish has a broad, depressed body, and its greatest length exceeds 20 feet. The largest examples have saws 6 feet long and a foot wide at the base, with teeth several inches long. The saw-fish is without economic value and is never sought, but it has the faculty of getting entangled in the fishermen's nets and badly damaging them in its struggles to escape, so that the fishermen regard it as a nuisance and have to handle it with care in order to avoid the serious injury that might be inflicted by a lateral sweep of a big fish's saw.

MAN-EATING SHARKS 40 FEET LONG

When giant fishes are mentioned most people will at once think of the sharks, among which, indeed, are found the largest fishes now existing. Of the many species of sharks noteworthy on account of their size there are about half a dozen which are preëminent. These differ much in their disposition, some being as harmless as doves and others the incarnation of ferocity.

The sleeper shark (*Somniosus microcephalus*), whose scientific name fits it so admirably, appears to have developed its



MAN-EATER SHARK

body at the expense of its brain, for it is a sluggish, stupid glutton, about six times as long as an average man. At home in the Arctic regions, it sometimes makes visits as far south as Cape Cod, the British Isles, and Oregon. It is most often observed lying quietly on the surface, apparently dozing and easily approached, but at times, when hungry, it rouses itself and fiercely attacks whales, biting huge pieces out of their sides and tails, and when feeding on the carcass of a whale which has been killed by hunters it is so voracious that it permits spears and knives to be thrust into it without seeming to take any notice.

One of the most prodigious and perhaps the most formidable of sharks is the "man-eater" (*Carcharodon carcharias*). It roams through all temperate and tropical seas and everywhere is an object of dread. Its maximum length is 40 feet and its teeth are 3 inches long. While there are few authentic instances of sharks attacking human beings, there have undoubtedly been many cases where sharks simply swallowed people who had fallen overboard, just as they would swallow any other food. How easy it would be for a man-eater to devour a person whole may be judged from the finding of an entire hundred-pound sea-lion in the stomach of a 30-foot shark on the California coast. A certain man-eater 36½ feet long had jaws 20 inches wide, inside measure, and teeth 2½ inches long. This may have been the "great fish" of the scripture narrative, and it is possible that at that time much larger man-eaters existed than are now known, as shark teeth with cutting edges 5 inches long have been found on the sea-bottom, and these are believed by naturalists to have belonged to sharks not long dead. The phosphate beds of South Carolina yield very large fossil teeth of a shark which was related to the man-eater of the present day; judging from the comparative size of these teeth, Professor Goode thought that sharks 70 or 80 feet long must have been common.

THE "GREAT FISH" WHICH SWALLOWED JONAH

Many years ago a Norwegian bishop in a learned paper brought to the attention of the scientific and theological worlds a shark which he attempted to prove must have been the "great fish" that swallowed Jonah. This was the basking shark (*Cetorhinus maximus*), known also as the elephant or bone shark, which is an inhabitant of the polar seas, but occasionally strays as far south as Virginia and California, and in former years was not rare on the United States and British coasts. The species has the habit at times of collecting in schools at the surface and basking in the sun with its back partly out of the water. It reaches a maximum length of 50 feet and is exceeded in size by only three or

four animals extant. Provided with small teeth, it feeds on fishes and floating crustaceans, and is not of a ferocious disposition. It is dangerous only by virtue of its great bulk, and when attacked its powerful tail easily demolishes boats. In former years the basking shark was hunted for its oil on the coasts of Norway and Ireland; it was also harpooned on the shore of Massachusetts in the early part of the last century, and as many as 12 barrels of oil were sometimes obtained from the liver of one shark. There are many records of basking sharks 25 to 38 feet long from the coast of New York, Massachusetts, and Maine, but the species has not been common in our waters in recent years.

The largest of all fishes, the largest of all cold-blooded animals, and the largest of all existing animals, with the exception of a few species of whales, is the whale shark (*Rhincodon typicus*), originally described from Cape of Good Hope, but now known from India, Japan, South America, Panama, California, and various other places, a small specimen having been obtained on the Florida coast a few years ago. This shark has a very broad and obtuse snout and an exceedingly wide mouth armed with numerous minute teeth; the dark-colored body is marked with many small whitish spots. The species is stated to attain a length of 70 feet and is known to exceed 50 feet. Notwithstanding its immense size, however, it is harmless to man unless attacked, and feeds on the small creatures for which its teeth are adapted. Its huge bulk makes it dangerous in the same way that a whale is dangerous. Years ago it was reported that the sperm-whale fishermen at the island of Saint Denis, in the Indian Ocean, dreaded to harpoon a whale shark by mistake, and stories are told of how a harpooned fish, "having by a lightning-like dive exhausted the supply of rope which had been accidentally fastened to the boat, dived deeper still, and so pulled a pirogue and crew to the bottom."

PLUNGE OF A HARPOONED WHALE SHARK

RIBBON-FISHES

The ribbon-fishes constitute a group chiefly noteworthy for their shape and the circumstances under which they have been met with, although some of them are among the most elongate of fishes. Imagine a creature one foot high, three or four inches thick, and more than 20 feet long, with the consistency of a wet towel, and you will have some idea of a

ribbon-fish. What would otherwise be only a plain band is ornamented with most delicate fin-tufts on head, tail, and body. Dr Günther remarked that "some writers have supposed from the great length and narrow shape of these fishes that they have been mistaken for 'sea serpents,' but as these monsters of the sea are always represented by those who have had the good fortune of meeting with them as remarkably active, it is not likely that harmless ribbon-fishes, which are either dying or dead, have been the objects described as 'sea serpents.'" On the other hand, Goode and Bean, in their Oceanic Ichthyology, say that "it seems quite safe to assign to this group all the so-called 'sea serpents' which have been described as swimming rapidly near the surface with a horse-like head raised above the water, surmounted by a mane-like crest of red or brown."

One of the most interesting of the ribbon-fishes is the oar-fish (*Regalecus glesne*), of which a number of examples have been found on the coast of Europe but only a few on the shores of North America. The common name refers to the blade-like expansion at the end of each ventral fin. Specimens have been known to reach a length of 20 feet, and much larger ones undoubtedly exist. One that went ashore in Bermuda in 1860 was 17 feet long after capture, but was thought to be much larger by the people who saw it in the water, and was described as having "a head of an immense horse with a flaming red mane." This species was not recorded from America until February, 1905, when a mutilated fish was found at Anclote Keys, on the west coast of Florida.

It is a matter of considerable interest that a second specimen should have been taken in February, 1909, at Captiva, Lee County, Florida. It was not quite dead when picked up, and exhibited the beautiful coloring for which these fishes are noted. The body was bright silvery, rivaling the tarpons, while a continuous fin of blood-red hue extended from head to tail, and on the head were a number of scarlet hair-like streamers. According to Mr F. E. Brockway, of Beach Haven, Pa., who found the fish and has communicated this information to the NATIONAL GEOGRAPHIC MAGAZINE, this example was 10 feet 8 inches long and 3½ inches thick.

Our knowledge of these fishes is due to no activity on the part of zoölogists in finding their habitat and collecting them therein, but to the circumstance that when they die or lose their equilibrium they fall upward and float on the surface, whence they are picked up or drift ashore. Nearly all the specimens known have been found dead or dying, and few, if any, have been secured in deep-sea collecting apparatus. This suggests how fragmentary must be our knowledge of the larger animals of the oceanic abyss and how possible it might be for unknown monsters to exist there in abundance. The appliances employed for securing animals from the depths are adapted only for the capture of comparatively small creatures lying on or within a few feet of the bottom and of so sluggish a disposition that they permit a net very slowly scraped along the bottom to scoop them up. If a net having a mouth ten feet wide and two feet high were slowly drawn for short distances and without selection of locality along the surface of the earth by a rope attached to an airship floating one to two miles high, how many bears, deer, lions, boa constrictors, alligators, to say nothing of elephants, giraffes, and rhinoceroses, would likely be caught and hauled up to the ship, even if the net were drawn during the darkest nights?

OUR PACIFIC NORTHWEST

By N. H. Darton, U. S. Geological Survey

VISITORS to the great Alaska-Yukon - Pacific Exposition in Seattle this summer will be greatly impressed by the wonderful diversity of features and products presented by Washington and Oregon. They will find plains and prairies, high mountains and wide valleys, arid lands and regions well watered by nature. The desert plains and ridges are treeless, while in the great forests of the western slopes are some of the largest woodlands and finest timber in the country. The two states constitute a somewhat isolated province. On the east are the high mountains of the northern Cordillera, and on the south is the high, rough, thinly populated district of northern California. On the north is the Canadian wilderness, and on the west the Pacific with a wild, rough coast broken by but few harbors.

Twenty-five years ago this province had but a meager population. Now it is occupied by about 1,600,000 persons, and the number is increasing more rapidly than in any other large section of the United States.

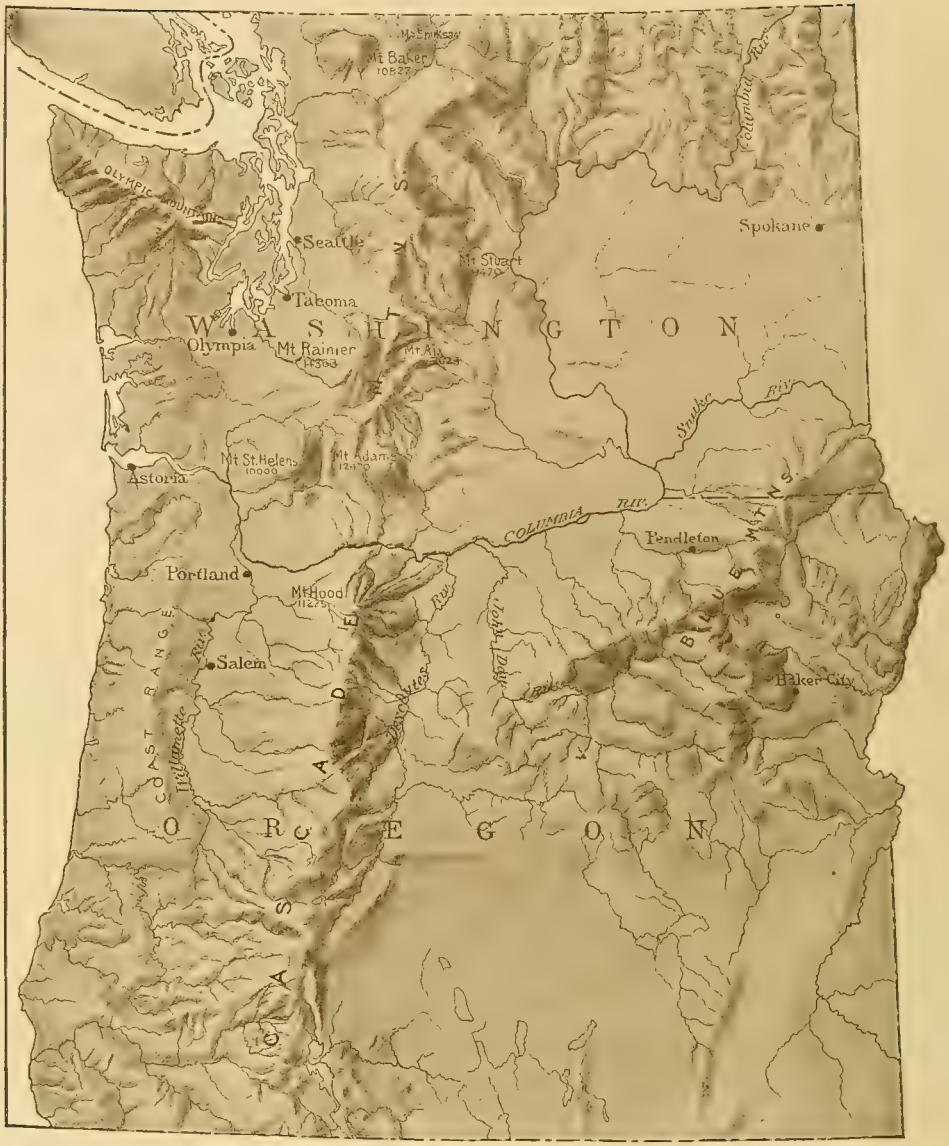
One of the most important reasons for this rapid increase in population is the fact that a large amount of valuable land is purchasable at low prices. There are now practically no more free "homesteads" available in most parts of the West on which a settler can make a *bona fide* home and a living. Much land can be purchased in the great Middle West, but it rarely is suited for high-priced agricultural products, and the region is now overcrowded with stock and sheep. The rapid growth of the Northwest country is well illustrated in Yakima County, where the population is 45,000, yet one of the first settlers is now an active business man but little past middle life.

Washington and Oregon are separated into two strongly contrasted physiographic provinces by the long, high range of the Cascade Mountains, which extends from north to south across their western portion. To the west is a zone plentifully supplied with rain by the moist air from the ocean, while to the east is a great irregular basin with low or moderate precipitation. These features are shown on the rainfall map on page 647. In this map it will be seen that the southeastern portion of Oregon is a desert region, while on the immediate ocean coast the rainfall is over 70 inches, and in places the amount is 100 inches a year. The contrast is strongly expressed in the vegetation; there is a dense forest with heavy undergrowth extending from the Cascade summit west, while to the east are wide areas of treeless plains or ridges with open pine woods.

WEALTH IS INCREASING RAPIDLY

Five great continental railroads reach the Pacific in Oregon and Washington and handle a vast volume of freight. The great ocean to the west is the outlet to many foreign markets, and the steamship trade, rapidly increasing in volume, now carries abroad nearly $90,000,000 worth of freight from the larger ports of the Pacific Northwest. All kinds of industries are developing rapidly, some of them supplying all local demands and others shipping widely to other parts of this country and abroad. The invested capital is rapidly growing on the profits which it is gaining, and as much of it is local, the region is becoming independent of Eastern financial aid. Owing to this fact, there is diminishing danger of serious disturbance by the depressions which are felt every few years in other portions of the Union.

It is claimed that climatic conditions aid the prosperity of the far Northwest, for the moderate temperatures are highly favorable to labor, and undoubtedly a pleasant climate attracts population. There is surely a great contrast between one's feelings on an average summer day



OUTLINE MAP OF WASHINGTON AND OREGON

in Portland or Seattle and in Saint Louis or Chicago. One of the most significant indications of the progress of a region is the extension of railroads into it, for the far-sighted builders of railroads usually make careful estimates of the business to be expected. There is more activity in this respect in the Northwest than in any other part of the country, both in extension of old systems and the building of new roads. One of the most notable events in this direction was the completion in 1908 of the new line down the north bank of Columbia River, which affords a continuous down-grade route jointly for the Northern Pacific and Great Northern roads. It cost $10,000,000, but is a most important artery. The

RAINFALL MAP OF WASHINGTON AND OREGON

completion of the Chicago, Milwaukee and Saint Paul Railroad into Tacoma and Seattle marks another most important stage in transcontinental trunk-line communication.

PUGET SOUND

The ocean commerce finds its principal outlets from Puget Sound and Columbia River.

Puget Sound is one of the most remarkable water bodies in the world. It carries tidewater inland from the Pacific Ocean for 200 miles, with channels so deep from the Straits of Fuca to many of its head branches as to accommodate the largest vessels. The shore-line is so irregular that its length is about 1,500 miles, and there are numerous branching bays which afford safe harbor and great water fronts for wharfs. It is free from reefs or shoals, and the straits are wide open to the ocean, without bar or other obstructions to delay entrance or require pilotage.

It is an interesting fact that the Straits of Fuca are 800 feet deep at their mouth and 200 feet at the narrows to the east. These straits and Puget Sound are an old valley system excavated by streams

when the land was high and now flooded by tidewater, owing to a general subsidence of the coast region. Most of the Alaska trade comes into Puget Sound, and it is claimed that this harbor is today nearer most Oriental ports than San Francisco. On its shores are the large cities of Seattle, with a population of 260,000; Tacoma, 100,000; Bellingham, 35,000; Everett, 25,000; Olympia, the capital of Washington, and many smaller places.

Columbia River is a wide watercourse for many miles above its mouth, but its depth is very much less than that of Puget Sound. The bar at its mouth has only 24 feet of water at mean low tide, and there are still shallower stretches on the route to Portland. However, the river is easily navigable for very large ocean vessels, which carry a heavy tonnage of imports and exports. Certain improvements now in progress by the government will deepen the water at the mouth of the river, and it is expected that Congress eventually will make provision for the excavation of a 30-foot channel all the way to Portland.

The Alaska-Yukon-Pacific Exposition at Seattle, prepared at a cost of $10,000,000, sets forth in glowing colors the great resources of the Northwest. It is not an anniversary, but simply an exposition, and while Alaska will be the special feature, Washington and Oregon will have much prominence and doubtless gain greatly by it.

SEATTLE

The Pacific Northwest has three great cities—Seattle, Portland, and Tacoma—all on tidewater near the west coast. Portland, the oldest, commands the Columbia River commerce, and Seattle and Tacoma are on the splendid harbor of Puget Sound. No large city in the world can boast of such rapid growth as Seattle has had in the last few years. According to data obtained by U. S. Geological Survey, in 1908 there were 7,901 permits issued, representing $13,777,329 for labor and materials. This is seventh in rank, or higher than Pittsburg or Boston. San Francisco at the same time issued 6,729 permits, with the high value of $31,668,341, but this was due largely to replacing the expensive down-town buildings destroyed by the fire.

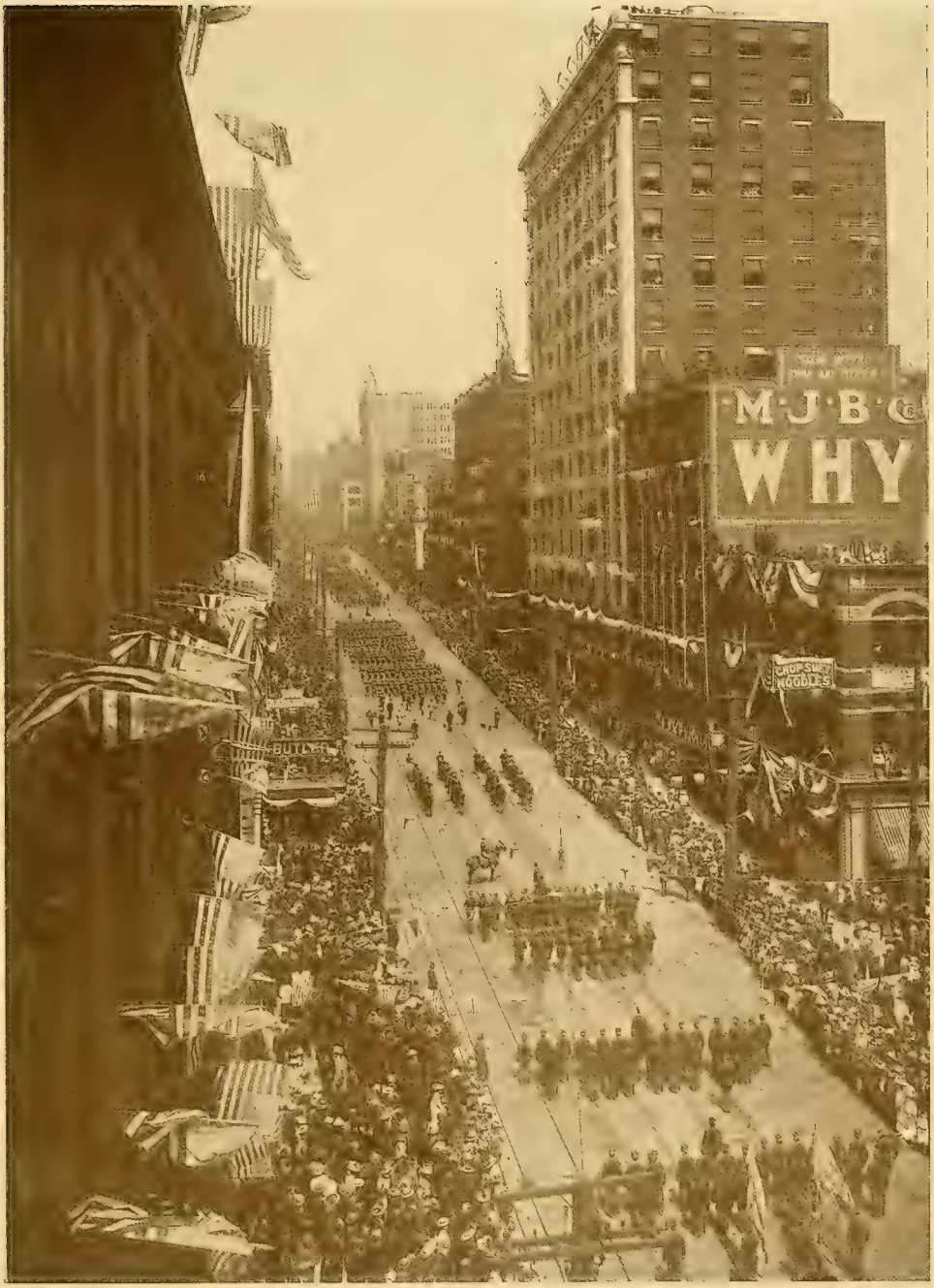
At the beginning of this year the population of Seattle was estimated at 260,000. When it is remembered that in 1880 the number was only 3,533, the gain is phenomenal. The city covers an area of 78 square miles, two-thirds land and one-third water; it has 413 miles of graded streets, 215 miles of sewers, 375 miles of water-mains, and 20 peaks with an aggregate area of 415 acres. Its factories have a $15,000,000 pay-roll, and their product is valued at $60,000,000. The exports in 1908 were $18,138,596 and the imports $12,961,094, besides a large coast trade, especially with Alaska. The bank clearings amounted to $429,499,251 in 1908.

Contrary to the idea which many people have, the rainfall of Seattle is considerably less than that of Washington, New York, or Boston, but as much of it comes in the rainy season of early winter, that part of the year is not altogether attractive.

The death rate is one of the lowest of large cities in the world. Much of the Seattle area is hilly, but the city has climbed the larger hills and leveled extensive districts, so the old prediction of rival cities, that the hills would restrict her progress, has been verified. Extensive swamp areas have been reclaimed, in part with material removed from the hills.

PORTLAND

Portland, with a population approaching a quarter of a million, controls the greater part of the lower Columbia trade. The city is beautifully built on broad terraces of moderate height on Willamette River, a short distance above its mouth. It has deep water to its extensive dock system, and its ocean commerce averages about $12,000,000 a year. New York is the greatest wheat-shipping port in the world and Portland is second. Its exports for the year ending June 30, 1908,



SECOND AVENUE, SEATTLE

This view of the leading business thoroughfare was taken on May 26, 1908, during the parade of the men from the Atlantic battleship fleet then in the harbor. Copyright by Asabel Curtis.

OLYMPIC MOUNTAINS, FROM SEATTLE

Looking westward across Puget Sound at the Olympic Mountains, which rise on the Olympic Peninsula lying between the Sound and the Pacific Ocean. This view includes the area recently set aside by the government as the Olympic National Park

were 13,411,581 bushels of wheat and 858,845 barrels of flour. Its manufactures are varied and extensive, but lumber leads, one great mill cutting one-half billion feet a year, worth over $9,000,000. Flour is a close second.

Several trunk railroads come into Portland, exchanging a great tonnage of freight of many kinds, which is rapidly increasing in amount. One great advantage that Portland has in freight is the down-grade haul down Columbia River. When Celilo locks are completed the river will be open for navigation all the way to the great wheat country to the east. If the government deepens the channel of the Columbia River to 30 feet, the larger ocean vessels can be accommodated and Portland's foreign commerce will be considerably increased in amount. The present limit of draft is 25½ feet.

Portland, and the Willamette Valley extending south, has a particularly equable climate, with average temperature of about 54°. In winter the daily variation in temperature is often only 5° to 10°. The mean annual precipitation is 41¼ inches, but much of it is in the rainy season, which begins late in the year. Green grass all the year round indicates the mildness of the winter climate, and there is no extreme heat in summer. Portland well merits her title of the Rose City, for roses abound throughout her resident section from April to Christmas. It has the low death rate of 9½ per 1,000 a year.

TACOMA

Tacoma is third in size of the cities in the Pacific Northwest, but it is full of enterprise and its rapid development sustains its more sanguine promoters in the expectation that it will finally become the dominating metropolis. It has some notable advantages. Primarily it lies nearer than Seattle to the great agricultural districts, so that the land haul to tidewater is less, especially by the new railroad line down the north branch of Columbia River.

The population is now about 105,000, yet thirty years ago it was only about 1,000. The death rate is remarkably low, only 8 per 1,000. The topography is favorable for growth, and the harbor facilities are all that could be desired. It has an ocean commerce of about $45,000,000 a year, about half of which is export trade. Its wheat shipments in 1908 amounted to 11,500,000 bushels of wheat and 800,000 barrels of flour, with an aggregate value of $13,500,000. It has extensive lumber business, having the largest saw-mill in the world. Its pay-roll in manufacturing plants in 1908 was $8,760,000, paid to 11,800 persons for an output valued at $43,677,418. Its building record for 1907 and 1908 was slightly over $4,000,000 for each year.

The climate of Tacoma is not materially different from that of Portland and Seattle. The mean annual temperature is 51.4° and the mean annual rainfall 45.4 inches. Most of the precipitation is in the rainy season, in the winter. Tacoma believes that her topography will greatly favor her growth. The city is built along the slope and over the top of a fine, wide plateau 300 to 350 feet high, extending far to the north, west, and south. The adjoining lands to the east are partly swamp and partly the flat bottom valley of Puyallup River, which offer very large areas to be reclaimed for docks and railroad yards. It is expected that long basins will be excavated in the reclaimed lands, so that 70 miles of dock-line may be developed, or more than the water front of New York city.

In the interior portions of Washington and Oregon there are many flourishing cities, notably Walla Walla, North Yakima, Wenatchee, Ellenburg, and Pendleton, with scores of smaller towns, which cannot be described in a brief article.

FAMED FOR THEIR APPLES

Oregon and Washington are more widely famed for their apples than for any other product. They are produced in large quantity, kept to a high standard by careful selection, and shipped to all parts of the world. London and other European markets receive many of them, and they bring fancy prices wherever

sold. The trees generally bear large numbers of perfect fruit of beautiful color, fine texture, and excellent flavor.

Hood River Valley, Oregon, is one of the most famous apple localities, but there are many others in both states. The fine apples usually sell for $2 to $3 per box of 50 pounds, or about a bushel, the price depending on variety and quality. Some range higher, and a record sale of Newtown pippins in London, in 1905, reached $5.43 a box. The market for them is always active, because the demand is far greater than the supply.

Many readers will be surprised to know that the total apple production of the United States has decreased from 60,540,000 bushels in 1895 to 25,000,000 in 1907. In 1908 Oregon produced 1,310,000 boxes of apples, valued at $1,215,000, and the total fruit crop was valued at $3,256,000. The value of the fruit crop of Washington is estimated at $19,000,000.

Extraordinary profits are reported from many apple orchards in the Northwest, $500 an acre a year being not unusual. With all other northern fruits the results are similar. The cherries raised in Salem, Oregon, and elsewhere are shipped far and wide. At many places they yield a profit of $500 an acre. Prunes are a great crop, and in the vicinity of Vancouver alone there are a half million producing trees. Oregon's prune crop of 1907 sold for $1,590,625. Strawberries are raised with great profit and shipped to Salt Lake, Denver, and as far east as the Mississippi Valley. They frequently are so large that 20 will fill a quart box, and they possess fine flavor and texture. Other small fruits give heavy crops and high profits.

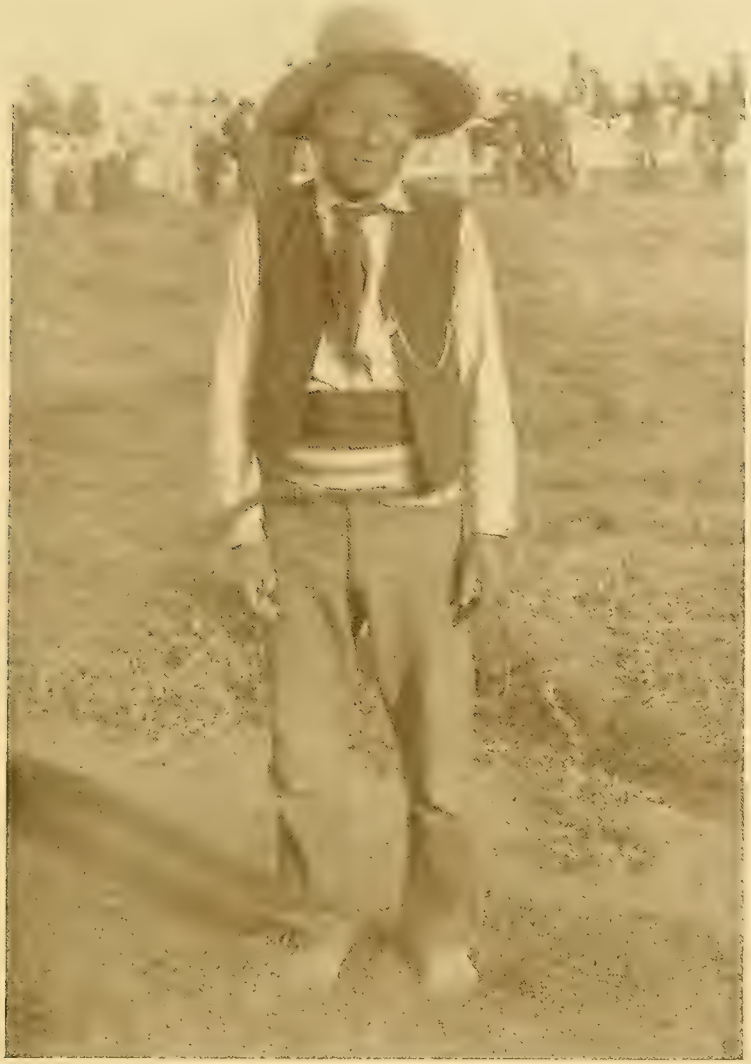
Almonds are now being produced in various places, notably in Klickitat County, southern Washington, where they yield from 1,200 to 1,500 pounds to the acre. The shelled nuts sell for 10 to 15 cents a pound. Walnuts have also an encouraging future, for they yield large returns. There is an active market for nuts in this country, for we import over 20,000,000 pounds a year.

MILLIONS OF BUSHELS OF WHEAT

The eastern half of Washington and a large part of northeastern Oregon is one of the greatest wheat regions in the world. Thousands of square miles of rolling plains formerly thought to be suitable only for cattle-ranging have proven to be most favorable for wheat. Crops of from 20 to 40 bushels an acre are obtained. In 1907 Washington produced 40,000,000 bushels and Oregon 18,500,000 bushels, and the area under cultivation is still on the increase.

Oregon is the leading hop-growing section of America, Salem being the great center of the industry. In 1907 the crop was approximately 24,000,000 pounds, or nearly half the entire crop of the United States. The selling price averaged only 10 cents a pound, but even at this low figure there was profit for Oregon, which is not the case in some other regions where the yield is lighter. Western and middle Oregon have the proper climatic conditions, and the yield is from 1,200 to 1,800 pounds to the acre, 1,500 pounds being frequently obtained. It requires 25,000 people to gather the crop and they are paid about $700,000 for their services.

While the region west of the Cascade Mountains has plenty of rainfall, the country east requires more or less irrigation. One of the greatest contrasts is that presented by the great desert plains before and after irrigation. Usually this contrast may be seen most impressively along the main ditches. On the one hand is the wide expanse of arid plains sparsely covered by sage brush and scattered blades of bunch grass. Below the ditches, where water is applied, are cultivated fields with splendid growth of alfalfa or grains, fine orchards yielding superior fruits of various kinds. These products support a prosperous population with fine farm-houses and bustling villages. Often the water is brought many miles from the mountains, but it is not expensive, considering the value of the products which it enables the farmer to raise. There are many private irrigation



YAKIMA INDIAN, ONE OF THE OWNERS OF LARGE AREAS OF IRRIGABLE LAND ON THE YAKIMA RESERVATION

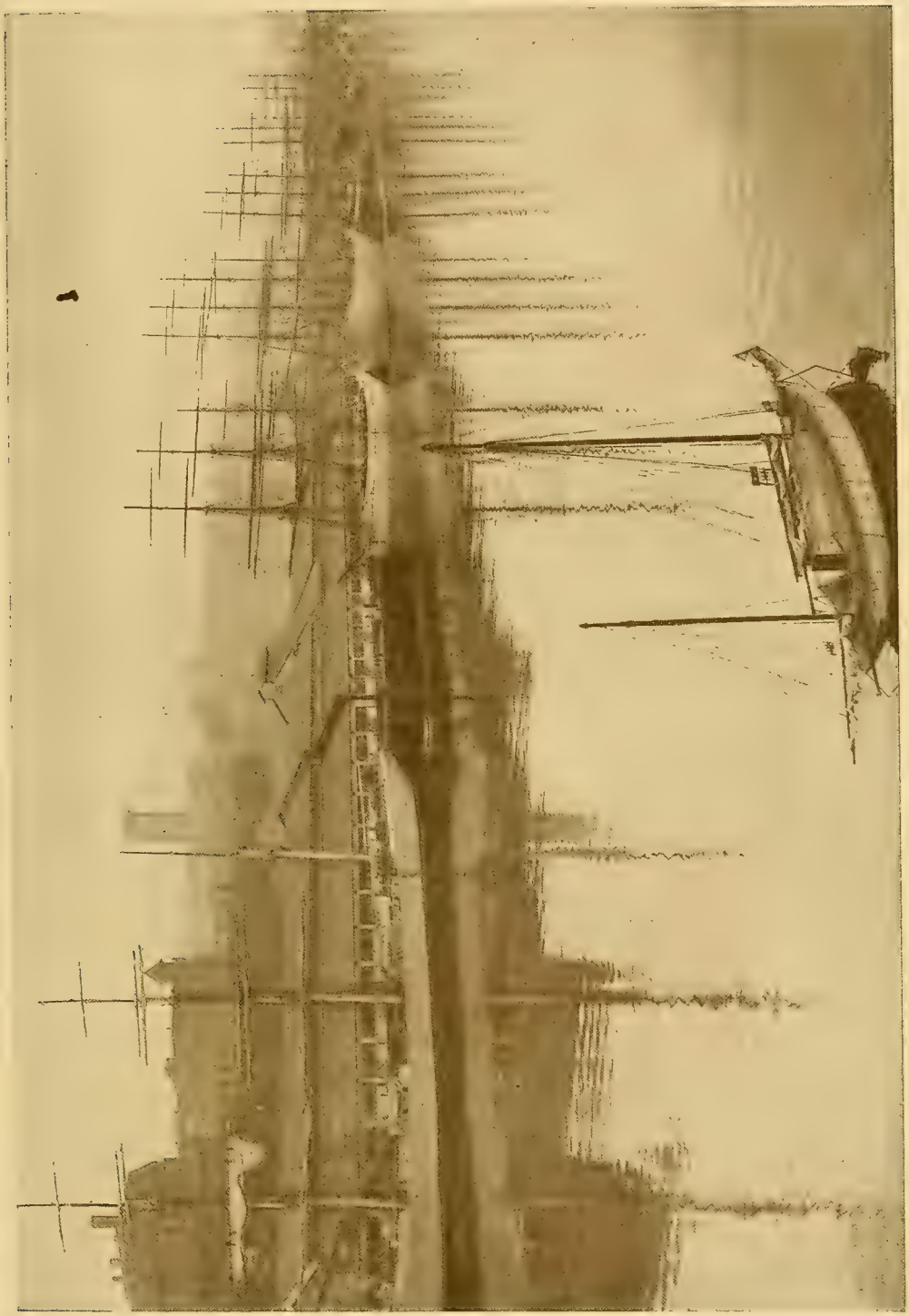
canals, some corporate and others mutual, and the U. S. Reclamation Service has in progress three great irrigation projects which will provide for the irrigation of a vast acreage of arid and semi-arid land.*

* See "The Call of the West," by C. J. Blanchard, NAT. GEOG. MAG., May, 1909.

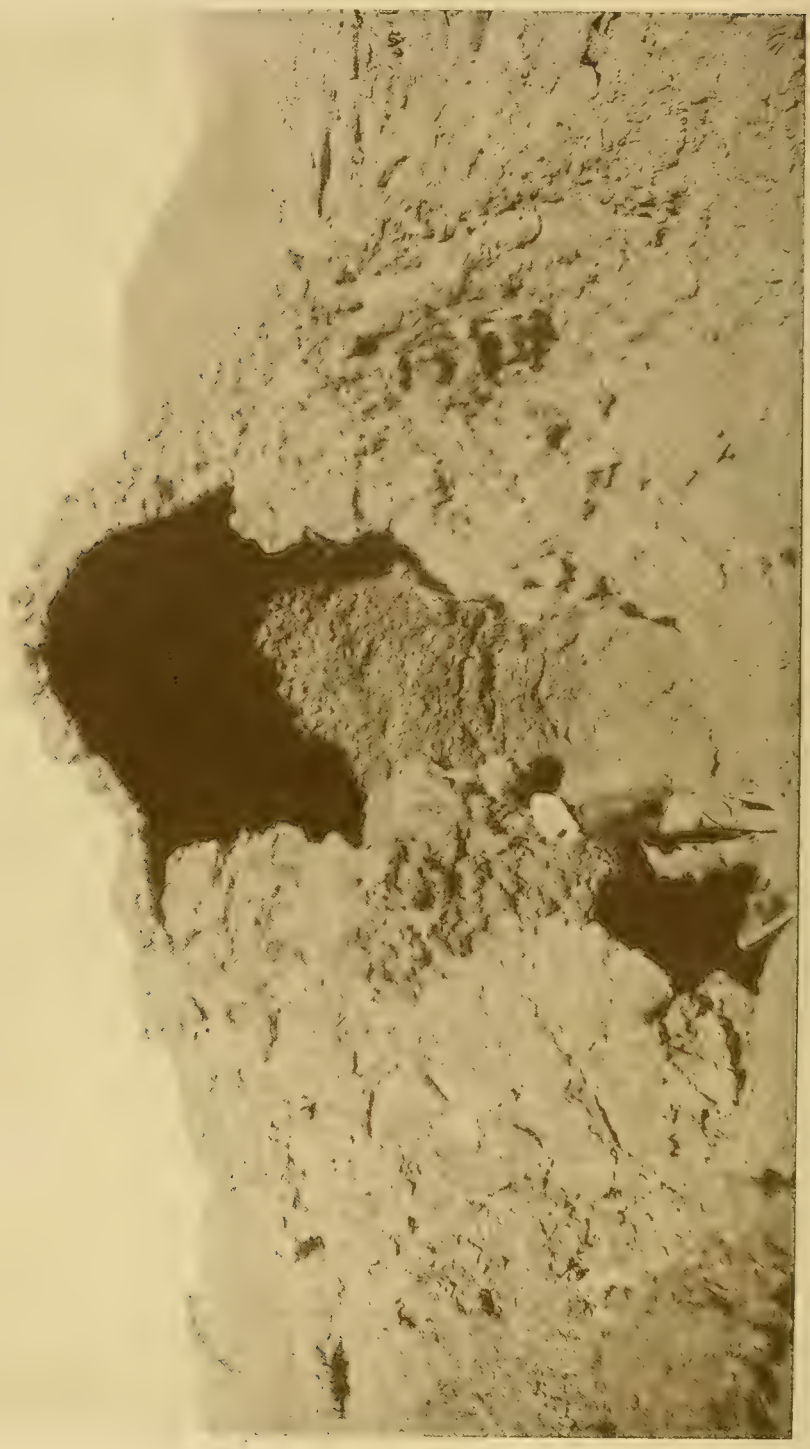
OUR GREATEST FORESTS ARE IN OREGON AND WASHINGTON

The greatest forests remaining in the United States extend west from the crest of the Cascade ranges to the ocean. They have been deeply invaded by the lumberman, but vast tracts of virgin

THE GATEWAY TO TACOMA, SHOWING NORTHERN PACIFIC RAILWAY YARDS AND ONE OF TACOMA'S LONG WHEAT WAREHOUSES: MOUNT RAINIER IN THE DISTANCE



VIEW OF TACOMA'S HARBOR, SHOWING SHIPS LOADING GRAIN AT THE LONGEST WHEAT WAREHOUSE IN THE WORLD



A BUBBLE OF LAVA ON ONE OF THE GREAT RECENT FLOWS OF EASTERN OREGON

forest remain. Much of the timber is of great size and of high quality. The government estimates for Oregon are about 213 billion feet of lumber, and for Washington about 195 billions. It is conservatively valued at $12 a thousand. The lumber business in Washington is about 4 billion feet a year, selling at $60,000,000, and Oregon has about half of this amount. Washington claims first rank in the lumber business, with 100,000 people engaged in its various branches on an annual pay-roll of $7,000,000. In cedar shingles alone she produces to the value of $15,000,000 a year.

The larger part of the forest growth is the splendid Douglas fir (spruce) which is illustrated on page 659. Large amounts of red cedar, spruce, and hemlock are also found. In the mountains east of the Cascades there is much yellow pine, which adds greatly to the lumber resources. The so-called fir is one of the most valuable woods known for structural work, having greater tensile strength than oak. Many trees exceed 200 feet in height, and usually they are free from flaws or irregularities of growth.

ABUNDANCE OF WATER POWER

Many of the streams of the far Northwest have large volume and great fall, thus presenting most favorable conditions for utilization for power. The Secretary of State of Washington has made an estimate for the larger rivers of 3,000,000 horse-power which can be made available by ordinary means, and the Oregon Conservation Committee estimates the total undeveloped water power in Oregon at 3,317,000 horse-power. These are large figures. Many of the streams mentioned will furnish from 100,000 to 400,000 horse-power. Some of the force is now being utilized, notably part of that of Snoqualmie Falls, which now furnishes Seattle and Tacoma with remarkably cheap power, carried 40 miles on wires. The plant is said to be the second largest in the United States; it cost $10,000,000.

The falls of the Willamette at Oregon City, a short distance above Portland, were harnessed long ago; they supply a large amount of power for local mills and half of the electricity for 115 miles of street-car lines in Portland. Rogue River and many other streams are also being used. Lake Chelan is a great natural reservoir. Fifty miles long and at an elevation 300 feet higher than Columbia River, it is capable of furnishing a large amount of power, only a small part of which is now being utilized. Water power in the region east of Tacoma will soon be harnessed, to add greatly to that city's supply of electricity.

Another valuable asset of the watercourses of the Pacific Northwest is the abundance of fish. The fisheries that are scattered over the two states are a source of great revenue. Columbia River is famous as the favorite resort of the superb salmon known as the Royal Chinook, which weighs from 60 to 70 pounds, and there are several other varieties.

On the lower part of the river the fish are caught in nets, but higher up revolving wheels are used, which often scoop up thousands of fish in a day. The salmon catch varies greatly from year to year, depending on the runs, but its value a year is about $3,000,000.

The extensive open range and the mild winters are especially favorable to stock of all kinds. Oregon stands sixth in the United States in its sheep and wool production. There are in that state about 3,500,000 sheep. A short time ago Oregon's wool production reached 22,000,000 pounds a year. Some of this from Willamette Valley sold for 30 cents a pound; in that section, moreover, the yield is often 15 pounds to the sheep. In eastern Oregon the yield is 6 to 9 pounds. This industry is also on the rapid increase in the state of Washington.

NOT RICH IN GOLD AND SILVER

The Pacific Northwest appears not to be as well endowed with the precious metals as California, Nevada, and the Rocky Mountain province. Washington is low in metal production, but has many promising prospects, especially of low-grade ores, which will eventually be worked with profit. The southwestern portion of Oregon has had profitable gold mines and placer workings ever since the

discovery of the first nugget, in 1851; the total output from that field has been at least $35,000,000. The placers are worked to the limit of the present water supply, but water storage will greatly increase the yield. Some of the washings produce from $6,000 to $50,000 every year, working only during the wet season; in general the ground runs from 10 to 30 cents a yard. A water power already developed on Rogue River by a 20-foot concrete dam at Gold Ray affords 10,000 horse-power, mostly utilized for mining in that district. In the Blue Mountains of eastern Oregon are many gold mines, mostly of small or moderate size, but with fair aggregate production, the total of which amounts to about $100,000,000. Near Baker City 450 stamp mills are in operation, with 2 to 20 stamps each. Oregon's total gold product for 1907 was $2,855,700.

Extensive deposits of copper ore are known in Oregon, notably in the lower end of Josephine County, and in various localities in central Washington. Coal is being mined in Kittitas, Pierce, and King counties, Washington. A group of mines in the western part of Kittitas County gives employment to 2,000 men and produces about 2,000,000 tons a year. The Coos Bay district, Oregon, has an annual production of 70,000 tons. Many other coal prospects are awaiting development.

Considerable platinum has been obtained in Oregon. Molybdenum is mined in central Washington, and mercury ores have been discovered at several localities in southwestern Oregon. Some of the dried-up lake basins in eastern Oregon contain extensive deposits of borax and soda, now beginning to be utilized.

The local demand for building materials on the Northwest coast can be judged from the fact that the cost of building in 1908, in Seattle, was $13,577,700, and in Portland, $9,446,982. There were 1,294,800 barrels of cement (valued at $3,884,400) used in Portland, Seattle, and Tacoma in 1907, of which about two-thirds was imported. Building stones, such as granite, marble, and sandstone, are available in large amount, but they are not extensively developed. Limestone suitable for the manufacture of cement occurs in certain sections and one large plant is now in operation on Skagit River, Washington. Cheap lumber has been an important factor in the rapid growth of the towns, but large amounts of stone, brick, concrete, iron, and terra cotta are also used in the cities.

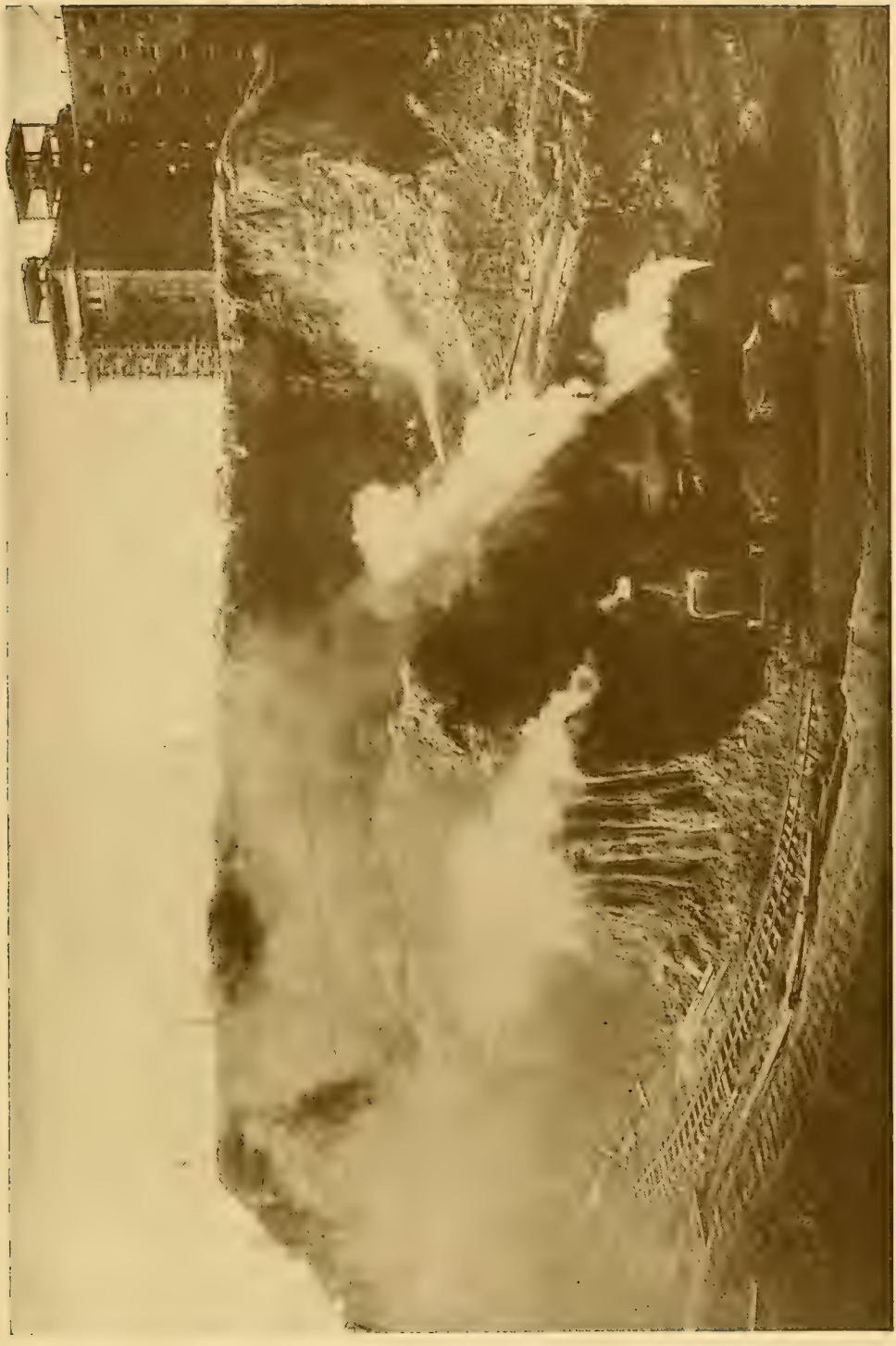
MAGNIFICENT SCENERY

The Pacific Northwest presents many features of notable scenic beauty. Probably the most admired are the great conical peaks of Mounts Rainier, Baker, Adams, Hood, Helens, and Jefferson, which are plainly visible from the coast. They are all volcanic and rise far above the surrounding lands into the realm of perpetual snow and ice. Some of these peaks are shown in views in this article, but photographs do scant justice to their beauty. Mount Rainier is often mentioned as the highest mountain in the United States, but its altitude is only 14,363 feet, or inferior to many other peaks in this country. It bears extensive glaciers, and these occur also on the higher of the peaks above mentioned. Some notable glaciers lie on Glacier Peak, in central Washington. Rugged, high mountain scenery is presented by the Cascade and other ranges of the region, some of which may be seen from the railroads.

The scenery of the great gorge of Columbia River is especially fine, with its cliffs of volcanic rocks over 1,000 feet high, over which are numerous waterfalls. Much of the land stretching away on either side of the gorge is an undulating upland, a fact which would hardly be suspected by persons traveling up the river. Lake Chelan, a most remarkable body of water, occupies a long, narrow gorge of the mountains of central Washington. It is 50 miles long and from 1 to 4 miles wide, with its water level about 300 feet above Columbia River. Much of the bold coast of Washington and Oregon is highly picturesque and the Puget Sound region is full of notable features, especially the great pile of the snow-clad Olympic Mountains lying between the sound and the ocean.

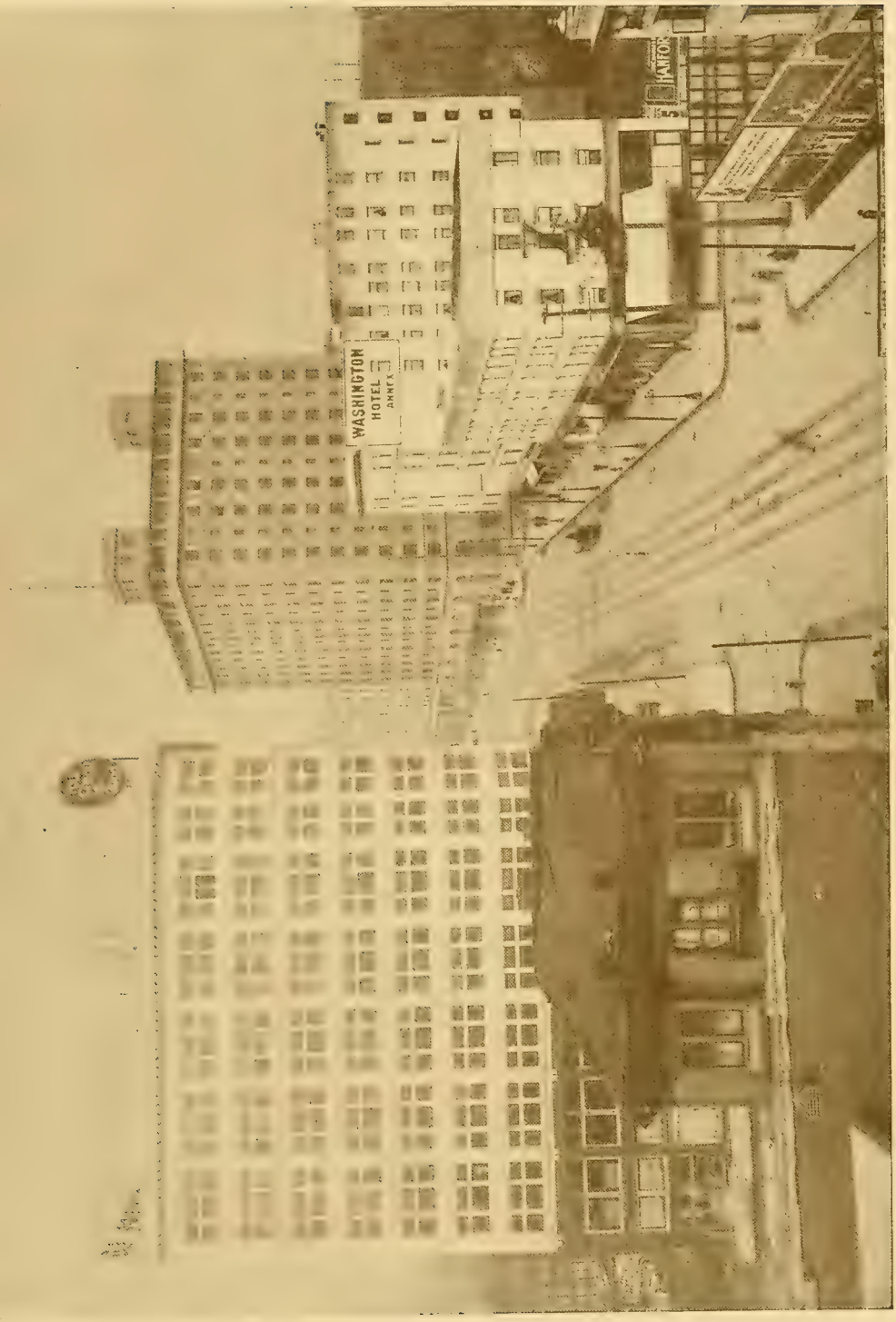
THE DOUGLAS FIR, THE PRINCIPAL TIMBER OF THE PACIFIC NORTHWEST COAST
(SEE PAGE 657)

This and the succeeding three pictures show what is being done in Seattle in the way of removing hills for the expanding business district. These regrading projects involve the removal of more dirt than any other modern enterprise outside of the Panama Canal. The total depth of the excavation, from the foundation of the Old Washington Hotel, shown in this view, to the foundation of the New Washington, was 108 feet.



WASHING AWAY THE GREAT HILL

THE LAST OF THE OLD HOTEL WASHINGTON



THE NEW HOTEL WASHINGTON

THE TALLEST TREE THAT GROWS

By Edgerton R. Young

IN these days, when the reforesting of the waste lands of our country is becoming a question of such national importance, the study of the relative value of different species of trees is naturally very essential.

Scientific parties are scouring the earth in search for new plants, fruits, and vegetables to add to our enjoyment and happiness. A good degree of success has already attended their efforts, and doubtless much more will yet be accomplished by them.

Owing to the rapidly increased price of timber and lumber, the matter of forest-growing is of vital interest to the great corporations like the railroads, manufacturing and building companies, that must have, for their very existence, vast quantities of timber and lumber. The timber required by the railroads for the one item of railroad ties, not taking into consideration the quantity used in the construction of cars and buildings, consumes the output of many hundreds of thousands of acres of timber lands every year.

While undoubtedly the valuable trees indigenous to America will be most largely replanted and utilized, many others that are not natives of this continent, when found by experiment to be easily grown and of value, will also be imported and largely cultivated.

In the case of the eucalyptus this has already been done, and so extensively is the tree now grown in California, and so many and valued are its uses, that it will be news to multitudes to hear that there still live many who remember when it was first brought into that state by the late Bishop Taylor from distant Australia, its original home.

It was a surprise, as well as a revelation, to find on our recent visit to Australia that in that far-away land, under the Southern Cross, were growing trees that towered in the air 150 feet higher than the great Sequoia, the famous red wood of our American West; and yet such is the fact, as some specimens of the *Eucalyptus amygdalina* reach to the great height of 480 feet. Specimens abound that are from 120 to 200 feet in circumference. The one partly shown on page 665 is 76 feet around several feet from the ground. It is, as are all the larger ones, practically of no use for commercial purposes, as the expense of cutting down such enormous trees and then getting their logs split up into pieces that can be handled is so great that these monsters are passed by the thrifty lumbermen for the smaller ones that are more easily handled.

The *Eucalyptus amygdalina* is the tallest, if not perhaps the largest, tree that grows. Specimens over 400 feet high are frequently found, while some have been measured towering up to 470 and 480 feet. The timber of these great specimens is easily worked, and, as it does not warp readily, is much used in carpentry.

On page 666 we see the method adopted by the skilled lumbermen of Australia in felling the eucalyptus trees that are not too large for their purposes. The bottom of the eucalyptus is generally so gnarled and twisted that the men construct a rough, but safe, platform, averaging from 12 to 20 feet from the ground. Here, with their great long-handled axes and saws, they work and toil until the giant tree, that perhaps for over a thousand years has lifted up its head in that land of almost perpetual sunshine, is laid low.

From the illustration on page 667 we can form some idea of the magnitude of one of these giant eucalyptus trees. In a great cavernous opening in its side was sufficient room for a commodious kitchen, with all of its appliances, for the accommodation of Lord Hopetown, Governor General of Australia, and his suite,

A EUCALYPTUS 76 FEET IN CIRCUMFERENCE (SEE PAGE 664)

during one of his visits to one of the regions where these gigantic trees abound in the State of Victoria.

The eucalyptus tree is a genus of trees and shrubs of the natural order of *Myrtacea,* embracing about 150 species. All but four of them are natives of Australia and Tasmania only. The eucalyptus trees are so abundant in many parts of Australia that over vast areas they are practically the only trees visible. The fact that the fully developed trees are destitute of symmetry and beauty robs the great Australian wooded regions of that attractiveness and charm which gives such pleasure and delight to the primeval forests of America.

One striking characteristic of several varieties of the eucalyptus is that, while they never seem to shed their leaves, they cast or slough off their bark in long strips every year. The leaves, which have a leathery appearance, contain a considerable quantity of volatile oil. The tincture or oil extracted from them has a bitter aromatic taste and is extensively used as a remedy for various diseases.

On the young shoots of many species the leaves in pairs are opposite to each other, as they appear on ordinary plants, while on the older branches the leaves are arranged alternately and grow in such a way that they present their edges to the sun. This seems to be nature's provision to protect them from the intense heat of the tropical sun of those lands where they most flourish.

The *Eucalyptus globulus,* generally called the blue gum, from its bluish-green leaves, is the variety most successfully grown in California. It has also been introduced and flourishes in India,

A EUCALYPTUS FOREST IN AUSTRALIA

Natal, Egypt, Algeria, and in various parts of southern Europe and in some other warm countries. It cannot stand the frost, and so must be classed among tropical trees. Perhaps only in the states of Florida and California can we expect to see it in perfection in this country; yet although its introduction into California has been of but recent date, already its value to that state has been very considerable. Its growth here has been so rapid that trees of 80 feet in height and over a foot in diameter have developed from the small planting of a dozen years. Its rapid growth makes it a valuable acquisition to those lands where in so many instances there was such a great lack of forest trees of general utility. In California its timber is being extensively used for telegraph poles, railroad ties, for fencing purposes, and in the manufacture of some kinds of furniture.

Some of the species of eucalyptus are much more valuable than others. There is also a great diversity both in their appearance and worth. One of the most valuable is the *Eucalyptus marginata*, popularly called the Jarrah wood. It grows to a great size and its timber is so hard that it is found to be especially valuable in the construction of wharves, as it resists the attack of the ship worms and borers that are so destructive to ordinary wood. Because of this quality it also enters largely into the construction of ships and is utilized in other marine uses.

Some varieties of the eucalyptus yield a kind of astringent gum or resin called Vino, while from others a species of manna—a hard, little, sweet substance—is obtained in considerable quantities. As an antidote against malaria and as being valuable in warding off or dissipating malaria in regions where malaria abounds, the eucalyptus has obtained a considerable reputation. Expert opinions seem to be divided as to the way in

ONE SIDE OF A EUCALYPTUS TRUNK USED AS A KITCHEN : AUSTRALIA (SEE PAGE 664)

which its beneficent results come about. Some think it is the result of the volatile oils which these trees give off through their leaves, acting as a neutralizing and even destructive power against the malarial matter in the atmosphere; others maintain that its beneficent results are caused by the fact of the trees being such rapid growers, and the great quantity of water they thus absorb and then give off purifies the atmosphere. Whatever may be the cause, the fact is evident that their presence in goodly numbers, planted in malarial regions, has produced most beneficent results.

The Roman Campagna especially has been greatly benefited, so much so that large portions once considered almost fatal to human life, and shunned and feared, are now the abodes of numbers of people who find, since the introduction of the eucalyptus trees, but little traces of the dreaded malaria that for ages once caused those regions to be so shunned and deserted.

In the low malarial regions around the Cape of Good Hope and in some similar unhealthful regions around Algiers and elsewhere, the same beneficent results have followed the introduction of the eucalyptus trees.

As yet no variety has been discovered that is able to withstand even a moderate frost, but the fact that millions of these trees can be raised so easily and quickly in California and Florida and perhaps in the warm places on the Gulf of Mexico, and that its timber can be so widely utilized, is a matter for congratulation to all who are interested in the conservation of our forests and also in the introduction of new varieties of trees that will add to the timber wealth of the country.

NOTES ON THE EUCALYPTUS TREE FROM THE U. S. FOREST SERVICE

MORE than 100 species of the eucalyptus tree have been introduced into the United States. They are, however, adapted to a subtropical climate, and only a limited portion of this country is favorable for their growth. The possibility of growing eucalyptus in any region is determined by the amount of cold that the young trees have to endure. Few of the species can survive a temperature below 20° F., and none of them a temperature of less than 12°.

In general, eucalyptus may be successfully planted in the sections of the United States suitable for the culture of citrus fruits. They are grown in nearly all the agricultural sections of California, along the coast of southern Oregon, and to a limited extent in Arizona, New Mexico, and western Texas. Several species have also been planted in Florida and along the Gulf coast. Here, however, occasional frosts have killed or severely damaged the trees, and for this reason planting has been discouraged.

The blue gum (*Eucalyptus globulus*) has a phenomenally rapid rate of growth. Seedling stands will average a height growth of 50 feet in 6 years and 100 feet in 10 years. Under very favorable conditions individual trees have reached a height of 125 feet and a diameter of 36 inches in 9 years. In sprout stands growth is even more rapid; trees frequently reach 3 inches in diameter and 35 feet in height in 8 months, while in 3 years a diameter of 7 inches and a height of 70 feet are often attained. In California, under favorable conditions, trees have attained a height of 175 feet and a diameter of 5 feet in 25 years. Although sometimes irregular in form, the tree tends to develop a straight, gradually tapering, unforked stem. In plantations the trunks become rapidly cleared of branches to a considerable height, but in the open, trees branch more widely and gradually develop a short crown of massive, spreading branches.

Blue gum is practically immune from disease. Where trees are reproduced by sprouts, the old stumps frequently decay slowly at the heart, while the sprouts remain unaffected. Growing trees are not attacked by insect enemies, but felled timber lying unbarked upon the ground is subject to injury by a wood-mining insect.

Blue gum rarely suffers any breakage of the limbs from winds, and the spreading root system renders the trees very wind-firm.

Fire is the greatest source of injury to eucalyptus plantations. Both the natural characteristics of the trees and the conditions within planted groves render them peculiarly susceptible to fire injury. The large quantity of litter—dry leaves, branches, and shredded bark—which accumulates beneath a stand is extremely inflammable. The bark of eucalyptus is so thin that the trees are injured even by light surface fires.

The wood of blue gum is very heavy, hard, strong, and tough, but it is not durable in contact with the soil. It is close-grained, and is split with difficulty after it has dried. It is less elastic than hickory, but it has been demonstrated by mechanical tests that seasoned blue gum timber is very little inferior in strength and stiffness to the best second-growth hickory. In appearance it closely resembles the wood of hickory and ash.

Blue-gum timber is utilized for a great variety of purposes in California. The wood is excellent for fuel, and in the treeless valleys has been the chief fuel supply for many years. In southern California the steady demand renders commercial planting for fuel very profitable. Eucalyptus timber has been extensively used in California for wharf piling. Blue-gum piles are in use in nearly every port on the California coast, and extended trial has shown that they resist the attacks of marine borers which destroy timber in sea water longer than other species commonly used for piling. Blue-gum timber has also been used to some extent for fence posts and telephone poles. The wood is not suitable for this purpose, however, on account of its short life in the ground. Seasoned posts last a little longer than green posts,

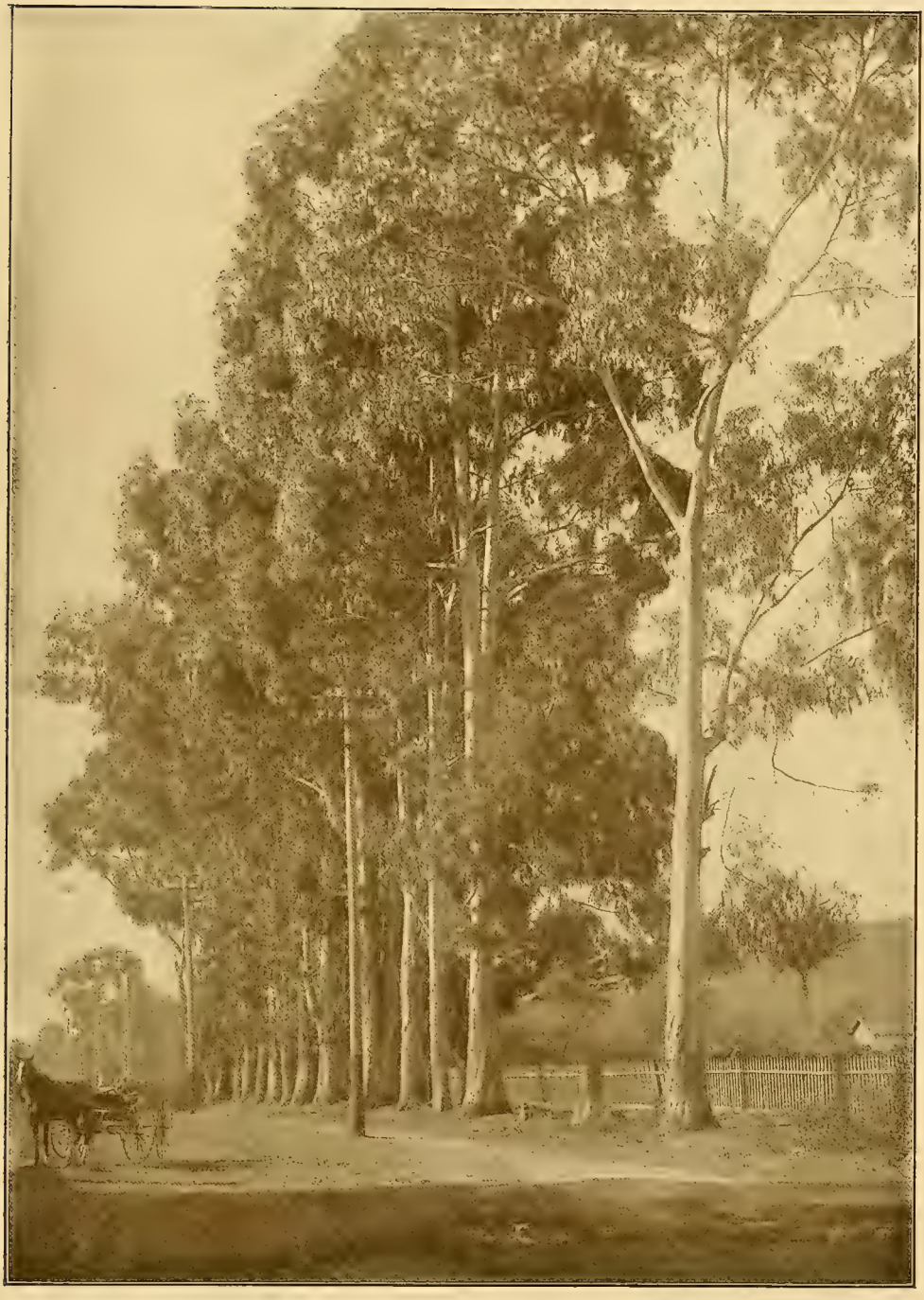


Photo from U. S. Forest Service

EUCALYPTUS GLOBULUS (THE BLUE GUM): SANTA BARBARA, CALIFORNIA

A row of trees 31 years old, ranging in diameter from 3 to over 5 feet. They were among the first planted in southern California

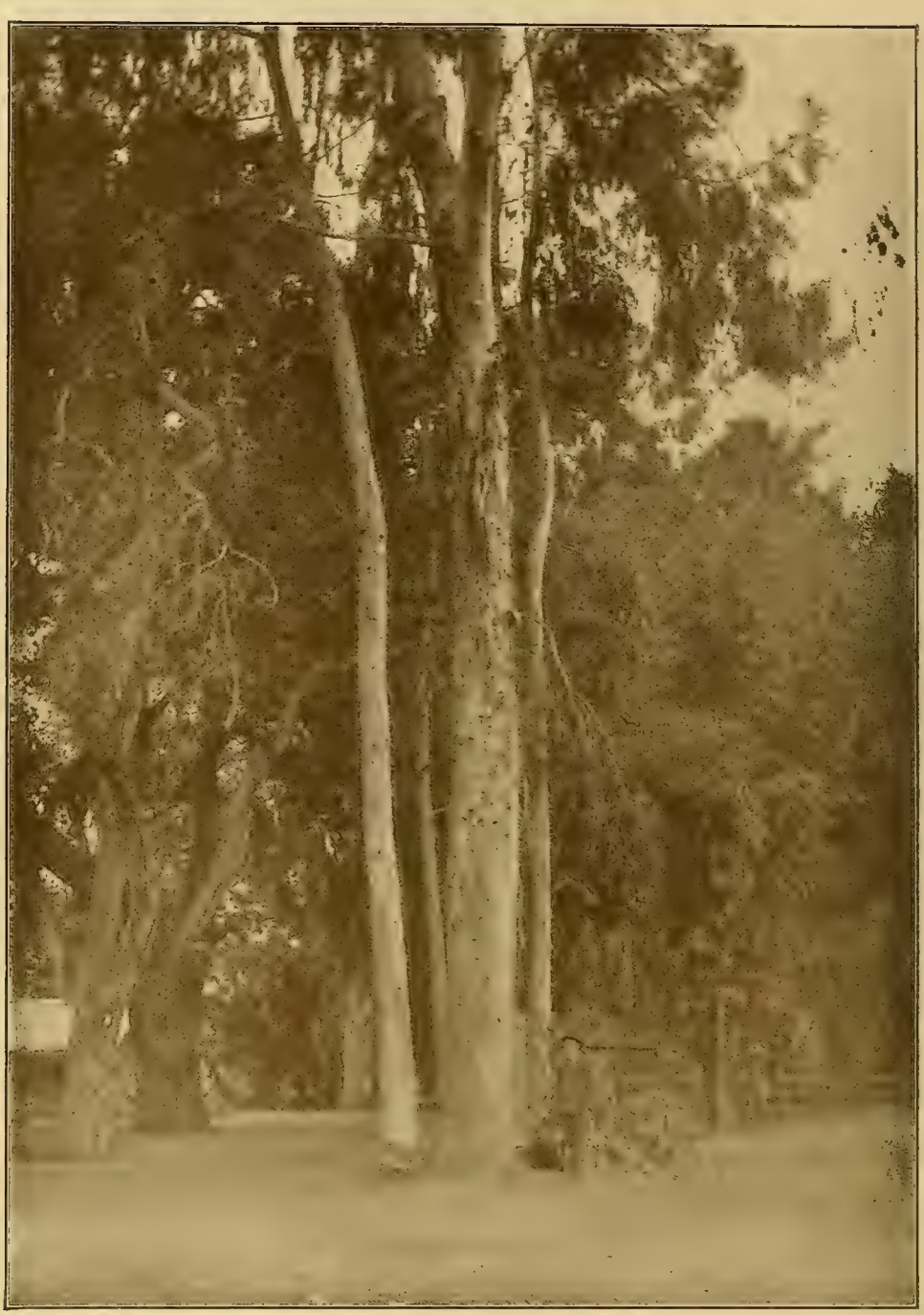


Photo from U. S. Forest Service

EUCALYPTUS GLOBULUS ON RANCH OF ELLWOOD COOPER, SANTA BARBARA, CALIFORNIA

Trees 24 years old. The largest eucalypt has attained in 24 years the diameter that the oaks have in over 200 years

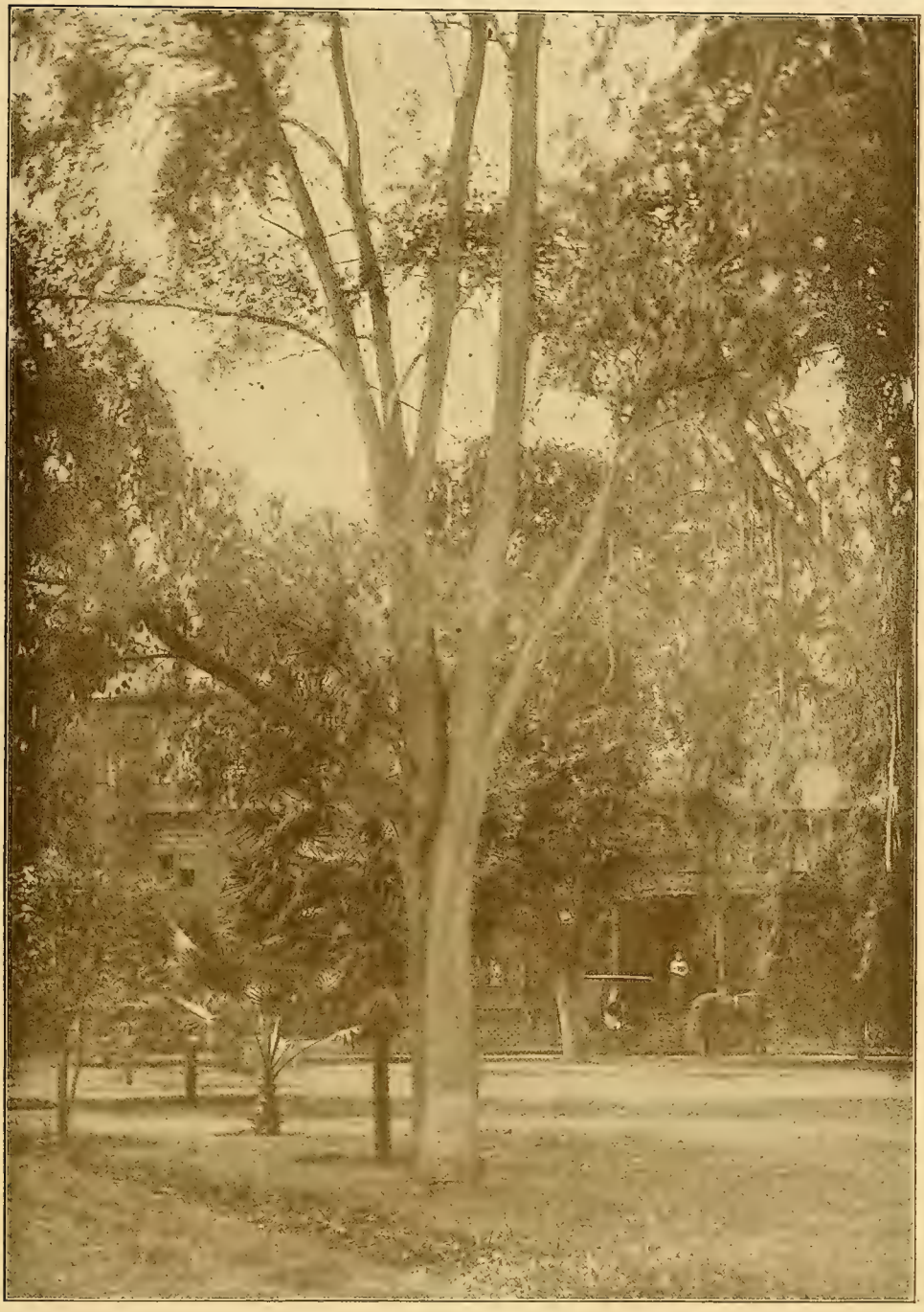


Photo from U. S. Forest Service

EUCALYPTUS RUDIS ON GROUNDS OF MINNEWAWA RANCH, FRESNO, CALIFORNIA

Tree 12 years old; diameter of trunk, 2 feet. This species endures more heat and severer frosts than any tree in the Southwest

Photo from U. S. Forest Service

EUCALYPTUS VIMINALIS: PASADENA, CALIFORNIA

Tree 24 years old; diameter of trunk, over 5 feet

and timber cut from the heart is more durable than sapwood.

Blue-gum timber has been used to a limited extent to determine its value for railroad ties. The results thus far obtained indicate that it compares favorably with second-grade pine-tie timber.

The lumber has been extensively used for vehicle stock and for the wooden parts of agricultural implements. It is also made into insulator pins for electric wiring, and is used for furniture and cabinet work, hardwood flooring, trip-hammer beams, the levers of windlasses, and the blocking for oil and wine presses, wood paving, pulley blocks, and belt wheels.

The extensive utilization of gum lumber has hitherto been prevented chiefly by the scanty supply of timber of merchantable size and by the difficulty experienced in seasoning the lumber without warping and checking. It is believed, however, that in the seasoning of gum no greater difficulties will be encountered than in the seasoning of any other hardwood of similar density and strength.

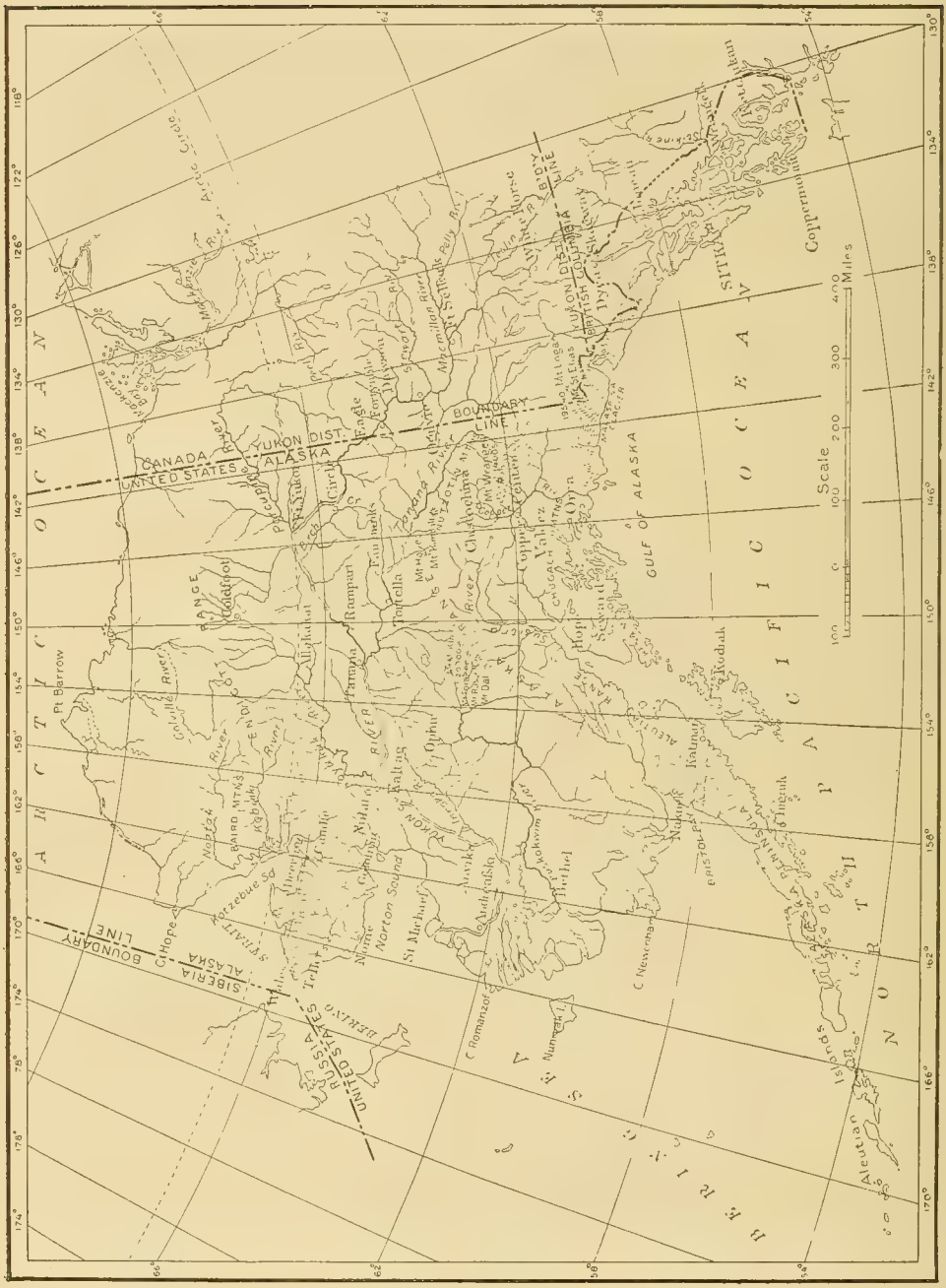
The esteem in which eucalyptus timber is held in California is based upon the exclusive use of blue gum. In Australia, however, this species is considered inferior in strength and timber value to several other eucalyptus. Strength tests of the timber of blue gum and other eucalyptus grown in California have sustained this opinion. It is therefore probable that eucalyptus are destined to enjoy yet greater favor when these other species become more widely used.

A product of considerable importance derived from blue gum is the oil distilled from the leaves. Eucalyptus oil is recognized as a valuable drug and is extensively used by pharmacists and physicians.

In many valleys of California eucalyptus windbreaks are considered absolutely necessary to insure the successful production of crops. They have been most extensively used to safeguard citrus orchards from strong and destructive winds in southern California, but they are now being established also for the protection of vineyards and orchards of deciduous fruits, olives, and walnuts. The blue gum excels other species for windbreak purposes on account of its height and the rapidity of its growth. The tall shafts of the trees bend before the wind and act as a cushion to deflect it upward over an orchard, whereas ordinary windbreak trees form a more solid wall, and the wind draws downward, forming eddies near the leeward side.

Eucalyptus reproduce readily by both seeds and sprouts. The trees bear seed in abundance annually, and under favorable conditions natural reproduction is freely established. Trees also sprout vigorously from both the stump and the roots, either after cutting or in response to injury. In California commercial groves are almost invariably reproduced by sprouts.

Plantations should be started with young trees and not by direct sowing. The opinion is generally held that eucalyptus seedlings are so difficult to raise that their propagation is impracticable except for expert nurserymen. In point of fact, blue gum is one of the most easily propagated species.



OUTLINE MAP OF ALASKA

MAGNETIC OBSERVATIONS IN ALASKA

By Daniel L. Hazard, Coast and Geodetic Survey

ONE of the prime requisites for successful navigation is a knowledge of the magnetic declination or, as the mariner calls it, the variation of the compass, in order that the navigator may properly direct his course when observations of the sun or stars are impossible. The portion of the earth's surface where the compass needle points true north is very limited in extent. Not only does the magnetic north in general differ from the true north, but the amount of difference changes in going from place to place; so that, for example, in crossing the United States from Maine to Seattle the direction of the compass needle would change from 20° west of true north to 23° east of true north.

At the present time the distribution of the earth's magnetism is known at least approximately for the greater portion of the earth's surface, and world charts are issued from time to time by the hydrographic offices of several countries, from which the variation of the compass at any place may be obtained with an accuracy not far short of the needs of the navigator. Up to comparatively modern times, however, no such charts existed, and it was necessary for the navigator to determine the variation of his compass at every opportunity, both on land and on shipboard. Hence the early magnetic data in Alaska, as in many other countries, have been obtained from the accounts of the voyages of those pioneers of the sea who visited that territory either in search of the Northwest Passage, or for the definite purpose of adding to our knowledge of the earth's surface, or perhaps purely from a spirit of adventure. Bering, Cook, La Perouse, Portlock, Meares, Malaspina, Vancouver, Disianski, Kotzebue, Golofnin, Wrangell, Franklin, and many others touched at various places in Alaska and each contributed his share to our knowledge of the earth's magnetism in that part of the world.

Early in the nineteenth century a fresh impetus was given to the study of terrestrial magnetism by the united efforts of von Humboldt, Gauss, Kupffer, and Sabine, and magnetic observatories were established in different parts of the world. In order to secure a wide distribution of stations, it was determined to place one of the Russian observatories in Alaska. In 1841 a wooden building was erected on Japonski Island, just across the harbor from Sitka, and observations were begun in March, 1842, by observers who had been trained for the work at Saint Petersburg. The observations, so far as they have been published, consisted principally of hourly observations of declination from 4 a. m. to 8 p. m., and in some years for the whole 24 hours. The work was kept up until October, 1867, when the territory became the property of the United States.

Since the acquisition of Alaska by the United States, the magnetic survey of the territory has kept pace with the charting of the coast and exploration of the interior, the most of the observations having been made by officers of the Coast and Geodetic Survey. Owing to the unsettled condition and inaccessibility of most of the territory, no attempt has been made to carry out a systematic magnetic survey such as is possible in a fully-developed country. With few exceptions the surveying parties engaged in other work have been provided with magnetic instruments, and magnetic observations have been obtained at one or more places in the area covered by each season's work.

In 1900, when an increase of appropriation made it possible for the Coast and Geodetic Survey to prepare for the erection of several magnetic observatories, the importance of having one in Alaska was recognized and Sitka was selected as the best available location. The site of the old Russian observatory on Japonski Island was no longer suitable;

so the observatory erected in 1901 was placed in the outskirts of Sitka, and there a continuous photographic record of the variations of the earth's magnetism has been obtained since January, 1902. In addition to providing the means for correcting the field observations made in other parts of Alaska, this observatory has contributed an important part to the general study of the earth's magnetism, and in 1906 was visited by Captain Amundsen on his return from the vicinity of the Magnetic North Pole, for the purpose of restandardizing his magnetic instruments.

The observations along the Alaska coast indicate the existence of areas of local magnetic disturbance, of sufficient magnitude, in some cases, to be noticed by the captains of passing steamers. In 1903 a detailed magnetic survey was made of Douglas Island and the vicinity of Juneau for the purpose of investigating one of these locally disturbed areas. A spot was found where the compass needle entirely lost its directive property and the dipping needle stood vertical, showing it to be a local magnetic pole.

In the summer of 1907, in order to supply in part the need of results in the interior, a party was fitted out for magnetic work exclusively, which went down the Yukon River from Dawson to the mouth and secured magnetic observations at numerous places en route. The U. S. Geological Survey and the Alaska Boundary Survey have also contributed to our knowledge of the distribution of declination in the interior.

At the present time we have a good knowledge of the distribution of the magnetic declination along the coast and interior passages from Cape Muzon to Kiska Island, and less detailed data from there to Saint Michael. In the interior we have little information except along the Yukon River and the overland route to the Klondike. As fast as the settlement of the territory advances and new routes of travel are opened, the magnetic survey will no doubt be extended.

AGRICULTURAL CAPACITY OF ALASKA

What Population Can the Territory Support?

By C. C. Georgeson

Special Agent in Charge of Alaska Investigations

THAT Alaska has agricultural possibilities of a sufficiently high order to make it self-supporting is no longer open to dispute. The range of products which can be raised there is, of course, confined to the hardy grains and vegetables of the kind grown in similar latitudes in northern Europe. I am aware that there are still many who doubt that agriculture of any kind is possible in Alaska and for their benefit I will adduce a few facts.

The Government has maintained agricultural experiment stations in Alaska for ten years. The stations, six in number, have been established at different times and in different localities in accordance with the means in hand and the requirements of conditions. Each has been devoted to one or more lines of work suited to the climate and soil. At these various stations all the hardy vegetables have been grown successfully every year. By the hardy vegetables I mean those which are usually grown in northern climates—Brussel sprouts, baricole (kale), broccoli, beets, cabbage, carrots, cauliflower, celery, endive, horseradish, kohl rabi, lettuce, mustard, onions, parsley, parsnips, potatoes, peas, radish,

rhubarb, spinach, rutabaga turnip, and also several of the condiments, mint, sage, dill, etc. All of these can be grown and are grown as far up as the Arctic Circle and beyond. Judge F. E. Howard of Coldfoot, Alaska, 60 miles north of the Arctic Circle, has grown potatoes, cabbage, cauliflower, rhubarb, and even cucumbers with success out of doors in that latitude. That all of these things can be grown, and usually with marked success, can no longer be disputed. They have been and are grown every year in thousands of little garden patches scattered widely over the territory. This is not saying that they can be grown with equal success in all places, and in all conditions, for on the point the elevation, soil, rainfall, and local conditions as to climate are important factors. Nor do I say that there is not now and then a cold summer in which only the hardiest of these things make satisfactory growth. But under normal conditions and with good culture all of these vegetables are grown successfully even beyond the Arctic Circle.

Turning from the vegetables to grains and forage plants, we can point to the fact that at our northernmost experiment station, the one at Rampart, in the Yukon Valley, in latitude 65° 30′, we have never failed to mature barley and oats in the most unfavorable seasons, and in normal years we have also matured winter wheat and winter rye, spring wheat, spring rye, and buckwheat. Clearing and preparation of land began there in 1900, and in 1901 we harvested the first half an acre of ripe barley and oats. As years have passed, the clearing has been extended, but the results have been equally gratifying with each succeeding year. Barley and oats of early and medium maturing varieties have always matured. Winter rye and winter wheat, and even winter barley, have matured at that station whenever the snowfall was deep enough to protect the grains from the low winter temperatures—that is to say, when these grains were covered with 30 inches or more of snow during the coldest period. That snow is the protecting agent is proved by the fact that whenever it is blown off on exposed hill sides the grain is winter killed, but wherever it is piled up in drifts or remains at the normal depth the grain comes through the winter in fine condition and matures during the latter half of August. If these results can be obtained at 65° 30′ north, they can be attained at hundreds of other places south of that latitude. Moreover, these results will be bettered. We have so far been compelled to use seed of plants and crops grown elsewhere in regions differing materially from Alaska conditions. We shall in the near future, by selection and breeding, be able to develop varieties which shall be better suited to Alaska than anything we now have, and it is therefore certain that the results will be improved upon.

So much for the cultivated crops which we know to a certainty can be grown. In addition to that, forage crops for live stock of many species can be successfully grown. Timothy springs up as a volunteer crop along every trail where hay is carried. We have also grown, at the experiment stations, meadow oat grass, meadow fescue, velvet grass, smooth brome grass, Kentucky blue grass, and several legumes. We can grow field peas, vetches, white clover, and alsike clover. These forage plants are not now natives of the country, but they can be made to thrive and furnish feed for livestock on many a mountain side which now produces only plants worthless for feed. But there are also a large number of nutritious grasses, native to the country, which in many places cover large areas with lush growth, on which live stock do well. We depend at present on the native grasses for feed for the cattle and horses at the various stations.

We have started a cattle-breeding station on the island of Kadiak. The cattle, pure-bred Galloways, will be fed and are fed exclusively on Alaska-grown feed. They thrive well on this feed and there is no reason why large herds of cattle and sheep cannot be successfully maintained at many

places in the coast region and also at some points in the interior. The summer and fall in the coast region in Alaska are at times very rainy and there is some difficulty in curing hay, nevertheless, with proper precaution we have never failed to make hay wherever we have kept live stock. Silage can, however, be made with success every year regardless of the rain. In that case the grass is packed in the silo (which is to say a building constructed for the purpose) wet and green as soon as it is cut. This green material undergoes a fermentation which then gives off a smell and has an appearance not unlike sauer-kraut. In this condition it will keep for a year or more and make excellent feed. Cattle are fond of it. One of the best grasses for this purpose is beach rye (*Elymus mollis*). It is a coarse, luxuriant grass, which grows more paricularly on the flat lands along the beach just beyond high tide. At the Sitka station we used work oxen for several years, which were fed during the winter exclusively on silage made chiefly from this grass. One year some was left over, and in August, before the silo was again filled, a portion of this old silage was analyzed and it was found that it had a nutritive value almost equal to good clover hay.

AREA OF AGRICULTURAL LANDS

Alaska has not been surveyed. We have therefore no definite data as to the actual area which can be utilized for agricultural purposes, but I believe that the following estimated figures are approximately correct: The Yukon Valley and the valleys tributary thereto, except the Tanana, 30,000 square miles; the Tanana Valley and its tributaries, 15,000 square miles; The Copper River Valley and its tributaries, 15,000 square miles; the Susitna and the Matanuska valleys, 15,000 square miles; the valleys of the Kuskokwim and the Nushagak rivers, 15,000 square miles, and the coast region 10,000 square miles; total 100,000 square miles, or in round numbers about one-sixth of the area of the entire territory. I do not mean to say all of this is good plow land, but I mean that there is at least 100,000 square miles in Alaska which can be utilized for culture and for pasture, and as a matter of fact the area is probably very much larger since a considerable of the mountain territory will afford pasture. Perhaps these data can be realized more fully if we compare them with similar data of better known areas. The states of New York and Pennsylvania have together an aggregate area of 94,000 square miles, which is less than the agricultural area in Alaska. The combined areas of Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, New Jersey, Delaware, Connecticut, and Maryland do not equal the agricultural area of Alaska.

WHAT POPULATION CAN THE TERRITORY SUPPORT?

In the face of these facts it is fair to infer that Alaska can support a permanent population. It would, of course, be too much to assume that Alaska can support a population equal to that of the states mentioned. In 1900, for instance, Massachusetts had a population of 348 persons to the square mile, New Jersey had 252 persons per square mile, New York had 152 per square mile, and Pennsylvania had 140 per square mile. It must not be forgotten, however, that these two large states have extensive mountain and lake areas which are not populated at all, but which are nevertheless counted in these density figures. But is it too much to say that the agricultural area of Alaska can support, and will eventually support, a population of 30 persons per square mile? This is but little more than the average density of the population in the United States exclusive of Alaska and Hawaii in 1900, but including our mountains, deserts, and forest areas, which are now uninhabited. The country which affords the best parallel to Alaska in point of latitude and climate is Finland. It is bounded on the south by latitude 60 and on the north by latitude 70. The main body of Alaska lies within these latitudes, though the two long arms of southeastern and south-

western Alaska extend some eight degrees farther south. Now, Finland has a total area of 148,000 square miles, or, in round numbers, one-fourth the area of Alaska. But one-third of Finland consists of marsh land and inland lakes, and another one-third is forest land. The agricultural area therefore, including the area covered by streams, towns, etc., does not exceed 50,000 square miles. But Finland supports a population of 3,000,000 people, or 60 persons per square mile of area utilized for agricultural purposes. Would it be unreasonable to suppose that the agricultural area of Alaska can, and eventually will, support an equal population of 60 persons to the square mile? If it is not, then Alaska can support a population of 6,000,000 people. But 3,000,000 may be deemed a conservative estimate.

We have reasons for believing that Alaska may equal Finland in agricultural production. Temperature is the chief controlling factor in the production of agricultural crops, and the temperatures, both in the coast region and in the interior of Alaska during the growing season, compare favorably with the recorded temperatures of Finland. The available data of the two countries are, however, not comparable, due to the difference in method of recording the data. In Alaska we base the average temperature on the recorded daily maximum and minimum temperatures—that is, an average temperature which is the mean of these two, while the recorded temperatures of Finland are based on three observations taken at seven in the morning, at two in the afternoon, and at nine in the evening. While these data include the maximum temperature of the day, which usually occurs about two o'clock, they do not include the minimum temperature, which occurs usually some time after midnight, and the mean, based on the three recorded figures, is higher than it would be if the minimum temperature was taken into account. Owing to this difference we cannot draw any accurate comparison, but the facts are we grow vegetables and grains with about the same success that these are grown in Finland. Finland is a noted dairy country. The agricultural exports consist chiefly of butter, cheese, and beef from slaughtered dairy animals. In Alaska cattle feed can be grown in any quantity and it can therefore also become a great dairy country.

DRAWBACKS TO SETTLEMENT

As yet there are but few farmers in Alaska, and these are chifly disappointed prospectors, who have found that they can make more money raising products to supply the local market than they can mining. Nor is there any immediate prospect that the country will be settled with a farming population. Congress has generously enlarged the homestead in Alaska to 320 acres, but even this does not attract prospective farmers except to a very limited extent. The reason is that it is too expensive for a farmer in the states to move his family and equipment to the northland and there begin as a pioneer. Lack of transportation facilities is a barrier at once both to the influx of people and to the export of such produce as they might raise. Until the transportation problem is solved Alaska will have but few immigrants aside from those who come for the purposes of trade and mining, but these conditions will be remedied as the resources of the country are developed. The rich deposits of gold, copper, and coal are bound to be developed, and with this development there will be a general advance, not only in transportation conditions, but in social and economic conditions, and there will be a corresponding growth in the number who take advantage of the agricultural possibilities of the country.

BOOK REVIEWS

In To the Yukon. By Wm. Seymour Edwards. Pp. 237, 6 x 8 in. Illustrated. Map and index. Cincinnati: The Robert Clark Co.

The volume would serve as an excellent guide to one with an inclination to follow the route set forth on the map showing Mr Edwards' itinerary, and it should appeal strongly to the traveler desirous of seeing the wonders of the Northwest country. Beginning at Cleveland, where the trip started, the reader is taken step by step northwest to Winnipeg, Banff, and Vancouver, then on board a ship for the journey into Alaska. The writer, evidently a close observer, gives his narration in a pleasing, straightforward manner, and has acquired the faculty of gathering and summarizing interesting, valuable data. An impartial summing up of conditions that existed in the Canadian Yukon several years ago is given, and the book is illustrated with many photos taken on the trip—actual scenes and happenings which give a very pleasing personal touch. J. O. L.

On the Mexican Highlands. By Wm. Seymour Edwards. Pp. 285, 6 x 8 in. Illustrated. Map and index. Cincinnati: Jennings & Graham Co. $1.75 postpaid.

To one who has never visited Mexico, or is about to go, this volume will give a clear and accurate idea of many quaint Mexican customs, fêtes, ceremonials, and ways of life. The author has a marked gift of narrative and a clear style, which make his book both entertaining and instructive, and the many photographs give color to the Mananaland of which he tells. Some of the best chapters tell of the crowning characteristic of Mexican life, bull fights, financial morality, and antique methods of mining. The descriptions are detailed and full of a freshness of viewpoint most pleasing, and the author gets far enough from the beaten track of the tourist to make it interesting.

J. O. L.

Camp-fires on Desert and Lava. By William T. Hornaday. Illustrated. Eight illustrations in color. New York: Charles Scribner's Sons. 1908. $3.00 *net.*

An account of a journey from Tucson, Arizona, across the desert to the little-known region of Pinacate, in northwestern Mexico. The enthusiastic and detailed description of the desert betray the experiences of a "tenderfoot," which Mr. Hornaday frankly admits himself to be. His portrayal of the fauna and flora is vivid and most interesting. The value of the book is greatly enhanced by its fine photographs, and those in color constitute a permanent contribution to our knowledge of the animal and plant life of the border region of Arizona and Mexico. They add greatly to the interest of the volume, which is in general worthy of marked commendation.

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THE NATIONAL GEOGRAPHIC MAGAZINE

THE COLORADO DESERT*

By W. C. Mendenhall, of the U. S. Geological Survey

With Photographs by the Author

THE Colorado Desert is not in Colorado nor even near that imperial State. Instead, it is in the extreme southeastern part of California and adjoining parts of Mexico, and represents one of the geographical and physical extremes for which California is noted.

This state extends for 1,000 miles north and south along our Pacific shore line, so that it passes from tropical to temperate conditions and from the most arid to one of the most humid sections of the continent. It includes the great Sierra, dominated by Mount Whitney, 14,501 feet above the sea, while just east of this culminating peak of the United States lies Death Valley, the lowest point on the continent, 276 feet below sea-level. These physical contrasts are matched by contrasts in vegetation and temperature, so that nearly every type of natural environment under which man exists is represented within the boundaries of the state, and often, as in the case of Death Valley and Mount Whitney, the juxtaposition is so immediate as to greatly accentuate the contrasts.

The valley of southern California, with its orange and lemon groves, its acacias and palms, its geranium hedges, and its riot of roses, is only 100 miles from the region that is the subject of this sketch, originally one of the most desolate spots on the globe, a veritable furnace in midsummer, with recorded official temperatures of 130 degrees in a shadeless land, but now destined through the agency of man to become a unique agricultural section, in which products not capable of production elsewhere in the United States can be successfully grown.

This desert derives its name from the Colorado River, its creator and until recently the erratic master of its destinies. Now the river is sullenly yielding to man the dominion that it has maintained since the evolution of the desert from sea bottom to arid valley. This evolution is a very recent event, in a geologic sense, and is one which the scientist is able to decipher with exceptional and satisfactory definiteness.

The desert valley is a northeastward extension of the depression whose southern portion is filled by the Gulf of California. During a time that is not at all remote, geologically speaking, the gulf occupied all of this depression, extending

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THE WATER LINE THAT MARKS THE SHORE OF THE LAKE THAT ONCE OCCUPIED COLORADO DESERT

inland 200 miles farther than at present, so that its waves lapped the base of the Santa Rosa Mountains and of San Jacquito Peak—physical features that are now far inland. At that time the mouth of the Colorado River was in the vicinity of Yuma, Arizona, 60 miles in an air line north of where it now is. Presumably, then as now, the river discharged annually into the gulf sufficient silt to cover one square mile to a depth of 53 feet. This material represented the products of the erosion of the great canyons in Utah and Arizona that are properly regarded as among the wonders of the western world.

At the point where the river discharged into the old gulf this silt was deposited as a great delta which gradually extended entirely across the gulf to the Cocopah Mountains on its western shore. As a result of this extension the water body was divided into two parts, the one an inland sea and the other the modern gulf, with about the same dimensions and outlines that it has today.

Delta growth, however, did not cease with this separation; silt continued to be brought down by the Colorado and to be deposited in its bed, along its banks, and in the still waters at its mouth. By this process a stream builds up its immediate channel until this channel is higher than the adjacent land on either side. It is then in an unstable condition and will shift to more favorable courses at times when extreme floods breach its immediate banks. By this process continually repeated it comes eventually to flow over all parts of its delta, building up each part in turn, until the whole stands well above sea-level. By such a process the Colorado River has built the famous delta lands of the Imperial Valley, and meanwhile has discharged alternately into the Salton Sink and the Gulf of California.

During those periods when it discharged into the sink this basin was filled with water and became an inland lake. During the other periods when it discharged southward away from the lake the supply of water which it contained quickly dried away and left the old lake bottom as the Colorado Desert. Doubtless this process was repeated many times, but there exists clear evidence of only the last occupancy. This evidence is in the form of a remarkably well-preserved old water line (see page 682) that rims the desert from Indio to the Cerro Prieto at a height of 40 feet above sea-level. On the rocky points that projected into the lake this shore line is indicated by thick deposits of calcium carbonate, usually spoken of as coral by the desert dwellers because of a fancied resemblance to this mineral. Where alluvial cones and the sandy floor of the desert formed the shore line, beaches have been developed, and although of soft sand and easily eroded, they are even now well preserved, thus testifying to the recency of the action that produced them. Over the floor of the desert and along the sandy beaches are myriads of shells of brackish water mollusks that lived in the lake. So abundant are these tiny fossils in the northern end of the desert that it has been called, on account of their numbers, the Conchilla (Little Shell) Valley.

It is not possible to state the exact period at which this lake disappeared. The time units of geology are too large and too indefinite to translate satisfactorily into years, so that when we say the last existence of the lake and its disappearance are the most recent of geologic events, we still leave the mind groping for a definite human standard of time. It is the crudest of estimates, merely a guess, indeed, to state that, reasoning from geologic evidence alone, it may be a thousand years since the lake vanished, yet it puts in concrete form such a guess as the geologist is able to make.

When human records are studied, some evidence on this point is found, but it is almost as uncertain as to time as that furnished by the physical features. The Indians now living at Toro and Alamo Bonito have distinct legends to the effect that at some time in the past the valley was occupied by a large body of water. They record that this water contained many fish, and that it disappeared grad-

THE LAKE THAT DISAPPEARED

General view southward along the shore line of Lake Cahuilla from a point upon the western edge of the Conchilla Valley, near El Toro Indian Reservation

ually until eventually the lake became dry. When questioned as to the date of this event they state that it occurred as long ago as the lives of four or five very old men, say three or four centuries ago at the most. It is not probable that their statements are at all accurate as to time, but by combining them with the evidence furnished by physical conditions it is possible to say that the lake may have disappeared and left the desert, as we have known it in historic time, 600 or 800 years ago.

With the establishment of routes across the continent, as a result of the discovery of gold in California in 1849, the westward-faring emigrant who selected the southern route regarded the Colorado Desert as the last and most difficult of the areas to be crossed before the promised land was reached. Its summer heat is extreme and its aridity is such that sometimes a year or more passes without a drop of rain, and the average for many seasons is less than 3 inches annually—much less in twelve months than in New York city in one month. The native vegetation includes such curious and distorted forms as the ocatilla, the spiny barrel cactus, the dreaded cholla, the leafless palo verde, the ironwood, whose fiber is so dense that the dry trunk will sink in water, and here and there clumps of greasewood or gray sagebrush.

Many legends have been related of the desert and the tragedies enacted within it, and among these one of the most interesting appeared in a magazine of wide circulation in September, 1891. This article was a graphic account of the finding of the hulk of an old Spanish galleon in the playa which at that time formed the lowest part of the desert.

The story was reported to have been told to the writer of the article by a prospector who, leaving the groups of springs in the vicinity of what is now the Toro Indian Reservation, attempted to cross the 100 miles of waterless desert that separates these springs from the old Butterfield stage line far to the south near the Mexican line. The narrator states that while riding down the western edge of the basin his attention was attracted by a curious object within the lowest part of the sink. He attempted to ride to it, but when still some distance away his horse broke through the salt crust of the saline marsh and was so injured that it had to be killed. The rider then tried to approach the hulk on foot, but the marsh was too treacherous and he was not able to reach it. He states, however, that it was distinctly visible; that it was clearly the hull of a vessel of antique type, with high prow and stern and stumps of broken masts.

After his attempt he retraced his steps to the western border of the desert and continued his journey to the south on foot, but long before getting to his objective point, Carrizo Station, the water that he carried in his canteen was consumed and he was in danger of death. He wandered on in delirium across the sandy wastes and through the bad lands, losing consciousness and reviving again and again, and was finally found barely in time to save his life by the keeper of the station. The tale is graphic and picturesque enough to be its own excuse, but it bears the earmarks of belonging to the type with which the imaginative and sardonic western plainsman is wont to beguile the tenderfoot.

No later explorer has found a trace of the old Spanish galleon, although many have visited the Salton Sink, and before its inundation by the Colorado River salt mining was carried out on a commercial scale within it for many years, so that it was intimately known. Furthermore, it must have been inherently impossible for any of the earlier Spanish explorers who passed up the west coast of North America and into the Gulf of California to penetrate to the Salton Sea, even had it existed at the time of their explorations, because so nearly did evaporation balance inflow from the Colorado that the stream connecting the lake and the gulf must have been too small for navigation and, if we may judge from present grades, too swift for ships of the old galleon type to make headway against the current. But even

SEVENTEEN PALM SPRINGS NEAR THE SOUTH END OF SANTA ROSA MOUNTAIN, ON THE WESTERN BORDER OF COLORADO DESERT

though there is no Spanish hulk in the bottom of the Salton Sink and no evidence that a lake had existed there within historical time, there can be no possibility of doubt of the existence of this lake in the latest of prehistoric periods.

The desert became known to white men through the activities of the early Spanish explorers, who, pushing northward from Mexico into Arizona and California, finally established an overland route connecting the Mexican missions with that Pacific Coast group that stretches from San Diego to San Francisco. The earliest of these Spanish explorers to leave a full record of his journeyings is Father Francisco Garces, who made at least four trips on foot through the Sonoran deserts into southern California, and on one of these journeys passed northward nearly to San Francisco Bay. The simple and devout padre, urged onward by the desire to extend his faith to the California Indians, at last lost his life in the massacre on the Colorado at the mouth of the Gila in 1774. This massacre checked the missionary activities for a time, but occasional explorers continued to penetrate the region, so that it had become known in a general way when the discovery of gold in California in 1849 led to the crowding of all the western trails by the argonauts.

One of the results of the stimulus given to western exploration by the gold discovery was the organization, under the auspices of the army engineers, of a series of expeditions whose object was the determination of possible railroad routes to the western coast. One of these explorations, commanded by Lieutenant Williamson, was assigned to the southwestern field, and to it was attached Prof. Wm. P. Blake, now Territorial Geologist of Arizona. In the course of the explorations of this party Professor Blake visited the Colorado Desert between November 13 and December 19, 1853. In the volume based on his explorations Professor Blake gives a complete and graphic account of the great desert and the phenomena displayed there. He recognized that the depression was but the bottom of a vanished lake, whose depth and extent, however, he was unable to outline definitely because of the lack of accurate maps. All later scientific descriptions of the desert are based on Blake's account and have done nothing more than add detail to the general principles which he outlined more than half a century ago. The work, though done in the briefest time and under great physical difficulties, has borne well the tests of all later investigations.

The desert, although known and traversed when necessary, continued to be shunned and dreaded until as late as 1879, when the Southern Pacific Railway became a transcontinental line by connecting New Orleans with Los Angeles along a route that crosses the southern extension of the Sierra by San Gorgonio Pass and follows the arid valley from north to south between the pass and Yuma. Since then access to this section has been relatively safe and easy, but it has been so uninviting and so apparently worthless that until about the beginning of the present century it contained no permanent human inhabitants except a few railroad and mine employees, who regarded their assignment as worse than exile.

Engineers, however, had long realized that the silt-covered floor of the desert required only the application of water to become a most productive agricultural area. The fact that it is a portion of the original delta of the Colorado River, across which that stream has meandered many times during the past centuries, means that the task of conducting Colorado River waters to it is a comparatively simple engineering feat; hence several attempts had been made to finance a plan to build such a system as the present Imperial Canal System before the successful organization of the California Development Company. Following the organization of this company construction was begun in 1900, and in 1901, in the month of June, water was delivered across the international boundary at Calexico and the first Imperial Valley lands were irrigated.

GENERAL VIEW OF THE UPPER END OF THE COLORADO DESERT FROM THE WEST SIDE BEFORE THE INFLOW OF THE COLORADO RIVER

GENERAL VIEW OF THE COLORADO DESERT AND THE SALTON SEA AFTER THE INFLOW OF THE COLORADO RIVER

END OF THE PROTECTIVE LEVÉE AT THE INTAKE OF THE IMPERIAL CANAL SYSTEM BELOW YUMA. CUT THROUGH AND DESTROYED BY THE COLORADO RIVER IN DECEMBER, 1906

THE GORGE CUT BY THE NEW RIVER AT CALEXICO IN THE SUMMER OF 1906
FERRY-BOAT OPERATED BY INDIANS

Development from that time until 1904 was rapid, but the silt carried by the Colorado River tended to clog the canals of the irrigation system and to make it difficult to secure sufficient water through them to irrigate the tributary lands. In order to overcome this difficulty, new intakes were repeatedly cut at the head of the system, and during the flood period of 1905 the river, enlarging one of these intakes, abandoned its normal course to the Gulf of California and, following the Imperial Canal nearly to the international boundary, flowed again into the Salton depression as it had doubtless done at many periods in prehistoric time.

So we had the strange spectacle of a mighty river wholly abandoning the lower 80 miles of its course and ceasing utterly to discharge into the sea. During the next two years repeated efforts were made to redivert the river from its course inland to that toward the gulf; but these were all unsuccessful until February, 1907, when, after the expenditure of hundreds of thousands of dollars, the stream was finally controlled and the menace to the valley removed; but during the two years or more of inflow a great lake nearly 500 square miles in area had accumulated in the bottom of the Salton depression to a depth of nearly 80 feet, inundating 40 or 50 miles of the main transcontinental line of the Southern Pacific and forcing that road to rebuild on higher lines at great expense.*

With the control of the river regained and the menace to property interests in the valley thus removed, development, suspended for a long time, has been resumed at a rate that promises to more than make up for the delay.

The principal elements in the history of this extraordinary region may be briefly summarized: First, in earlier prehistoric time it was an arm of the Gulf of California; then, perhaps during the Middle Ages of human chronology it had become an interior lake, separated from the gulf by the delta of the Colorado River; after its separation the lake eventually evaporated and its site became the hottest and dryest as well as one of the lowest points in the United States. It was in this condition when it first became known to civilized man.

By the practice of the art of irrigation a part of it was later transformed from an absolute desert to a unique agricultural community, but as an incident in this reclamation a lake has again been created in the bottom of the depression, and for a long and anxious period there was serious danger that the inundation might extend over practically all of the lands that had been reclaimed. Fortunately this menace is passed and development again continues unimpeded by fear that the erratic river will destroy what in times past it has created.

The desert is interesting for other reasons than those due to its strange history. Within it or about its borders are most striking land forms of bizarre types. East of Holtville is a zone of sand dunes 12 miles wide and 50 miles long—a region unsurpassed in aridity and in menace to the inexperienced traveler by the worst of the Saharan or Tibetan deserts. (See page 700.)

In the western edge of the Imperial Valley, at the east base of the Peninsula Range, are bad lands quite equal in picturesqueness and in uselessness to the worst of the Dakota bad lands. (See page 696.)

The rare torrential storms of the region have caused the streams that drain from the bordering mountains into the desert to cut strikingly deep, narrow canyons through the sandstones around the desert margin. Some of these cleft-like gorges are scarcely wide enough at the bottom for a man to pass, yet have walls two hundred feet high or more. Others are broader and deeper, but with sheer sides that cannot be scaled except where broken down at the junction of some tributary arroyo. (See page 693.)

Among the most incongruous elements in the desert physiognomy are two groups of mud volcanoes that seem uncanny, so strangely out of place are

* For further description of this break of the Colorado River see "The New Inland Sea," by A. P. Davis, in NAT. GEOG. MAG., January, 1907.

COLLAPSED MUD VOLCANO—A CALDERA IN MINIATURE—NEAR VOLCANO LAKE, MEXICO, 40 MILES SOUTH OF THE INTERNATIONAL BOUNDARY LINE

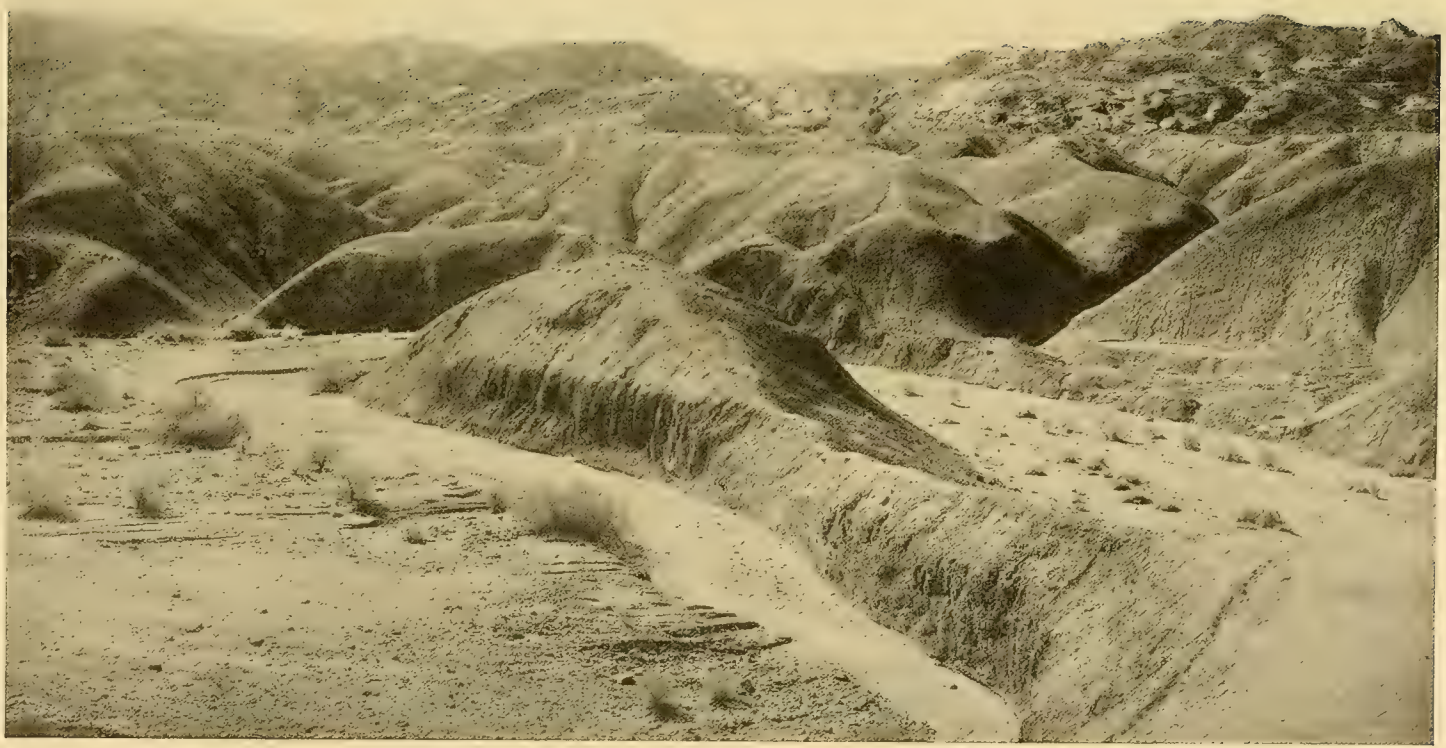
they in the featureless silt plain which constitutes most of the desert surface. The best known of these groups is now submerged by the Salton Sea. Its situation is about 6 miles south of the station of Old Beach, the junction point for the Imperial and Gulf branch of the Southern Pacific Railroad. These solfataras, before their submergence, were distributed in two or three sub-groups, near some mounds of volcanic rock which rise above the desert floor. They have been visited at various times by explorers and during at least one of these visits a tragedy was narrowly averted. The explorer, in attempting to cross the thin crust that covers the hot mud bog which separated the mounds from the solid ground around them, broke through the crust and was so scalded that his explorations had to be given up and his life even was for a time in jeopardy.

The craterlets of mud look more like irregular beehives in various stages of dilapidation than like any other familiar form which might be mentioned (see page 698). In the tops of these mounds there are often cup-shaped depressions, and from these or from vents in the sides steam and other gases are constantly rising (see page 699). These gases contain much sulphurous vapor, and this vapor, condensing as it reaches the air, lines the vents with brilliant yellow crystals and powders the adjacent surface with a golden dust that gives curious and even attractive effects. Round about the mounds are pools of hot mud or water, the latter often so acid that shoes or wearing apparel moistened with it are destroyed.

The second important group of solfataras lies not in California, but about 40 miles south of the international boundary in Mexico, along the western shore of Volcano Lake and near the base of a dark butte called Cerro Prieto. The volcanoes here cover many acres (see pages 698 and 699) and are much more active than those on the American side of the line. Many of them are boiling and bubbling continually, emitting weird muffled

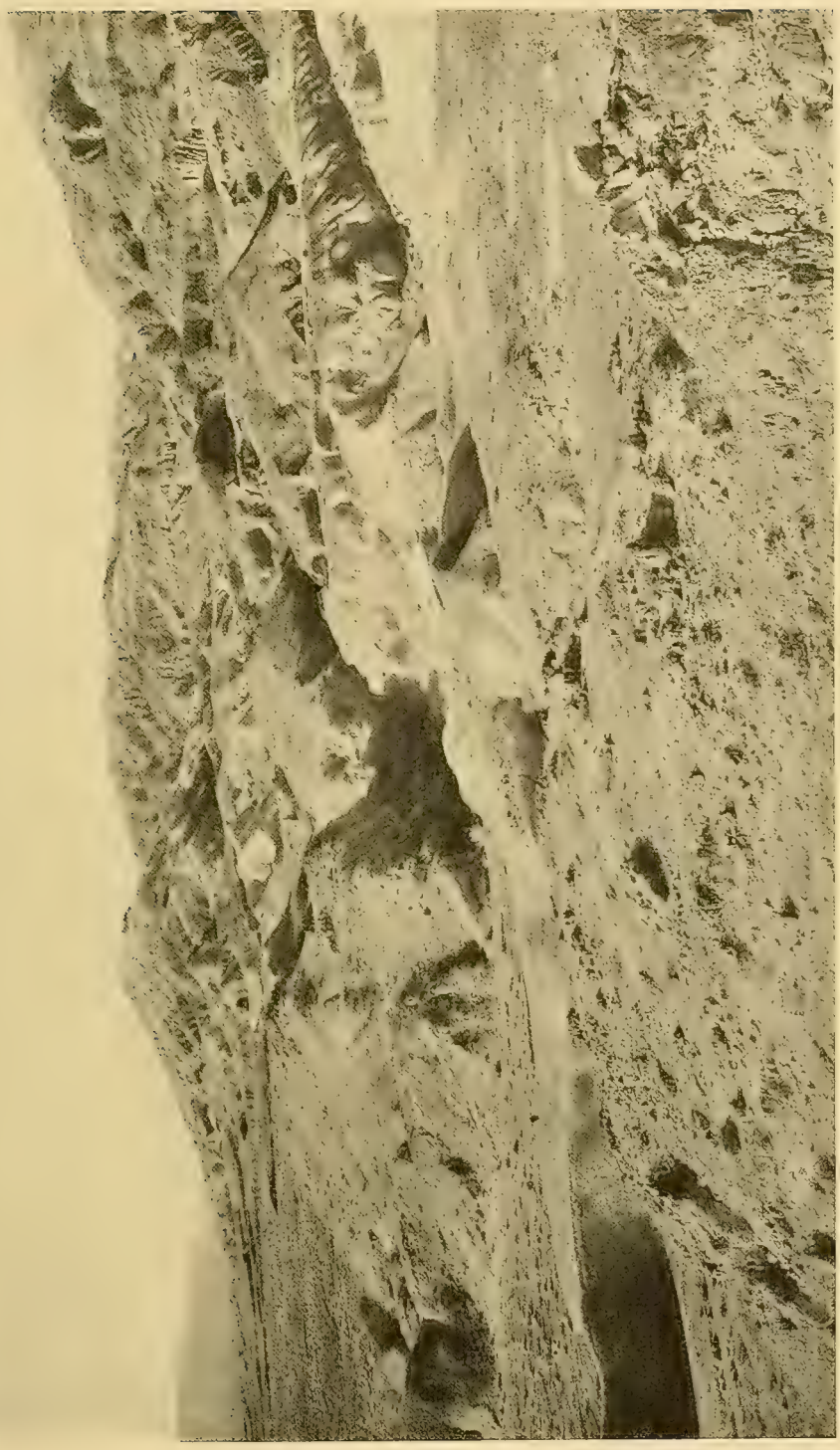
AN EXAMPLE OF DESERT EROSION. A DEEP-CUT CANYON EAST OF CONCHILLA VALLEY (SEE PAGE 691)

COYOTE WELLS VALLEY AND THE EASTERN FRONT OF THE PENINSULA RANGE VIEWED FROM THE SOUTH SLOPE OF CARRIZO MOUNTAIN



AN ARROYO WITH ITS SURROUNDING BARE CLAY HILLS IN THE CARRIZO VALLEY, A TRIBUTARY TO THE DESERT FROM THE WEST

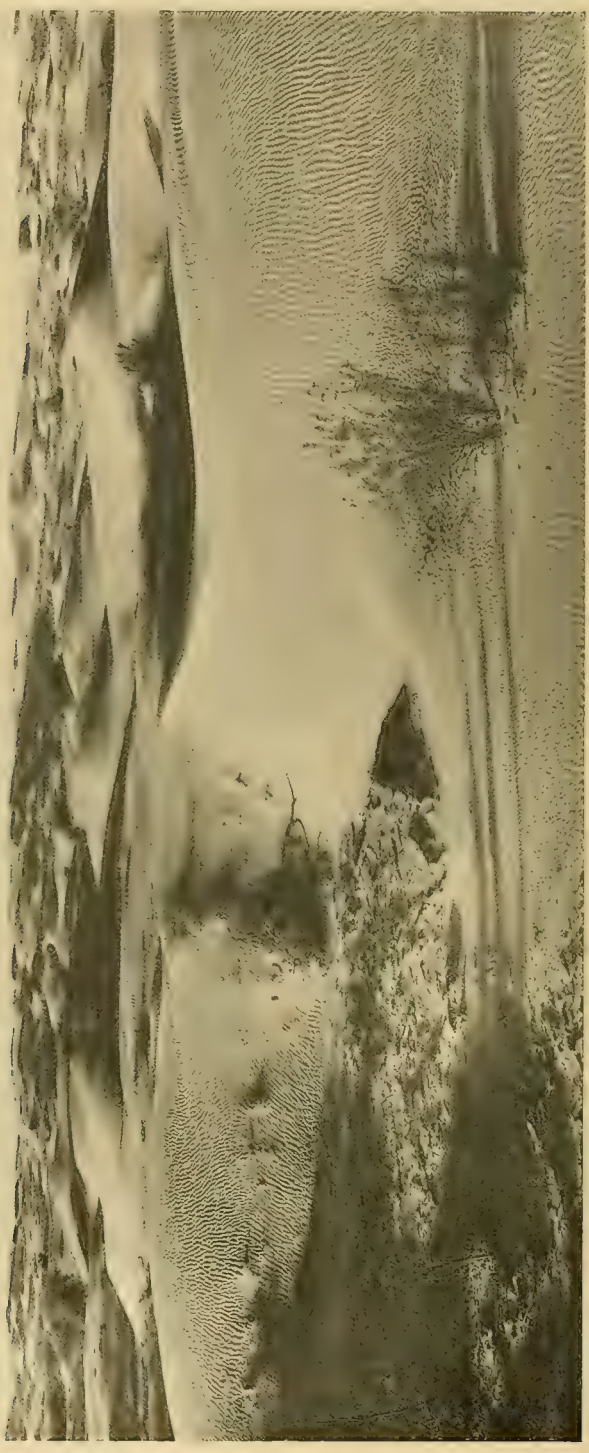
BAD LANDS IN THE COLORADO DESERT



THE SLOPES OF A DESERT RIDGE: THE SOUTH SIDE OF CARRIZO MOUNTAIN NEAR THE WESTERN EDGE OF THE COLORADO DESERT

A GROUP OF QUIESCENT MUD VOLCANOES ON THE SHORES OF VOLCANO LAKE, MEXICO, 40 MILES SOUTH OF THE INTERNATIONAL BOUNDARY LINE

MUD VOLCANOES IN ACTION NEAR IMPERIAL JUNCTION, CALIFORNIA



SAND DUNES THAT MARK THE EASTERN EDGE OF THE DESERT NEAR MAMMOTH STATION

sounds that give the vicinity an uncanny aspect. This effect, moreover, is increased by the strange hues of the surface, the white of the alkaline efflovescence being tinted yellow by the sulphur or dark red or orange by mercury sulphides.

A sharp bluff separates the area occupied by the solfataras from the flat occupied during times of flood by Volcano Lake, and small openings lead from the shore of the lake into this bluff. These openings, like the volcanoes themselves, usually discharge vapors, and from some of them hot springs or mud flows issue.

It is related that one of the riders employed by a big cattle company that controls the greater part of the range south of the line decided in a moment of alcoholic inspiration to explore one of these uncanny caves. He came out quickly, sobered and shaken, and started for his pony. "The crust's too thin in this neighborhood for me," he is reported to have said. "I don't believe the end of that hole is more than forty feet from hades, and while I'm a fair gambler and only an ordinary sinner, I don't want to take any chances hereabouts. Calexico and the forget-it-water for mine."

But for the sober man the region about Volcano Lake, although a veritable inferno in the desert summer heat, with the puffing of the steam jets, the sulphurous odors, the treacherous, hot marshes, and the weird coloring, is perhaps for that very reason an area of deep interest; but it is only one of many interesting features in a most unique and even yet very imperfectly explored corner of North America.

KING HERRING

An Account of the World's Most Valuable Fish, the Industries it Supports, and the Part it Has Played in History

By Hugh M. Smith

U. S. Deputy Commissioner of Fisheries

WHEN one takes a bird's-eye view of the fisheries of the world he quickly perceives that there is no family of fishes and no group of aquatic animals that contributes so largely to the support of the human race as the herrings. The family has 200 members, nearly all of which exist in great abundance.

In nearly every country having extensive fisheries some kind of herring is of importance, and in many countries representatives of the family are among the most valuable of the water products. Some of the herrings live exclusively in salt water, some exclusively in fresh water, and some alternately in the sea and streams.

Characters by which the herrings may readily be recognized are the presence of a single dorsal fin, which, like all the other fins, is composed only of soft or non-spinous rays; the absence of an adipose dorsal fin, such as occurs in the salmons and trouts; a swim-bladder, which communicates with the esophagus by a pneumatic duct; four gills; a forked tail; a terminal mouth with weak or deficient teeth; a fully scaled body but naked head; the absence of a series of "lateral line" organs, and a generally silvery coloration. The structure of the mouth parts determines the food, which usually consists of minute animals and plants, strained from the water by the numerous gill-rakers.

On the east coast of North America we have such well-known and important members of the family as the sea-herring, the shad, the river herrings or alewives, the West Indian sardine, and the menhaden, the last doubtless the most abundant fish on our shores. On the Pacific coast of North America are the California sardine and the sea-herring. On the shores of Europe are the Allice shad and the Twaite shad; the pilchard, which when young is canned under the name of sardine and sent to the outermost confines of civilization; the sprat, and the sea-herring. In the Caspian and Black Seas and in the Volga herrings occur in great abundance and are the principal fish of those regions. The seas that wash the shores of northern Asia, particularly those of Siberia, Korea, and Japan, teem with a number of kinds of herrings and sardines. In the waters of the Philippine and East Indian archipelagoes small and large members of the family abound. In the rivers of India runs the hilsa, which is similar to the American shad, and on the coast of India occur schools of the oil sardine. Herrings likewise exist in Australia and New Zealand; in the rivers and coastal waters of Africa, and at the southern extremity of the Western Hemisphere, where the Chili sardine abounds.

THE SEA-HERRING HAS DETERMINED THE DESTINY OF NATIONS

But the herring par excellence is the sea-herring of the North Atlantic and the scarcely distinguishable sea-herring of the North Pacific. This fish—biologically two species, commercially one species—is the most abundant and most valuable in the world, and is therefore entitled to be called king.

The sea-herrings are cold-water fish and reach their greatest abundance in far northern latitudes. The herring of the Atlantic, called *Clupea harengus* by Linnæus, has a remarkably wide distribution. On the western shores of Europe its southern limit is the Strait of Gibraltar, whence it ranges to the White Sea and the Arctic Ocean as far north as Spitzbergen, occurring in enormous numbers in the Bay of Biscay, North Sea, Baltic Sea, and Norwegian Sea. It is thus found on the coasts of Spain, Portugal, France, Belgium, Holland, England, Wales, Scotland, Ireland, Denmark, Germany, Russia, Finland, Sweden, and Norway. With Iceland as an intermediate station, the fish crosses to the shores of Greenland, and extends its range southward and westward to Labrador, Newfoundland, Quebec, New Brunswick, Nova Scotia, and the New England shores, going in winter occasionally to New York and exceptionally as far south as the Virginia capes. The North Pacific herring, first called *Clupea pallasi* by Cuvier and Valenciennes, exists in the same extraordinary abundance as the Atlantic fish and has also a very extensive range, being found from California to Alaska and from Siberia to Korea and Japan.

A tale as stirring as any fiction could be based on the part played by the sea-herring in the history of some of the principal countries. "Its spawning and feeding grounds have determined the location of cities," and in several instances the actual destiny of nations and the fate of monarchs appear to have been involved in the herring fishery.

Countries in which the quest of the herring is an important industry are the United States; the Canadian provinces of New Brunswick, Nova Scotia, Quebec, and British Columbia; Newfoundland; England, Scotland, Wales, and Ireland; Norway, Sweden, and Denmark; Russia; Germany; Holland; Belgium; France; Japan, and Siberia.

THE HERRING FORMS THE PRINCIPAL FOOD OF THE COD, HADDOCK, AND HOSTS OF OTHER FISH

The chief purpose the herring subserves in nature is to be the food of a host of other creatures, some of which are of great economic value. The most important of the fishes that subsist regularly on herring are the cod, haddock, hake, and pollock, all of which consume immense quantities of herring and her-

ring spawn. Mackerel, albacore, and various other high-sea fishes prey largely on herring at times, and numerous species of little or no value to man—like the sharks, dogfishes, sculpins, and flounders—often gorge themselves with herring and their recently deposited eggs.

Among the marine mammalia, whales, porpoises, dolphins, and seals prey on the herring and sometimes subsist almost entirely on this fish.

On parts of our northeast coast probably the worst enemy of the young herring is the squid, which frequents the inshore waters in immense numbers and is most adept and insatiable in capturing the unlucky herring, both in open waters and in the weirs of the fishermen.

Small fishes, birds, and a perfect host of other minor creatures find a large part of their sustenance in the eggs and young of the herring, and in the aggregate are doubtless much more destructive than any of the major enemies mentioned.

As the herring is probably more extensively preyed on than any other fish, and as it is entirely lacking in offensive and defensive powers, it is evident that its perpetuity depends on its abundance and its prolificacy.

THE WONDERFUL FECUNDITY OF THE HERRING

The average number of eggs deposited annually by a full-grown herring is 30,000. This is not a particularly large number by comparison with the egg-laying capacity of many other marine food-fishes, but it is noteworthy in view of the small size of the fish and its remarkable abundance. If all the progeny of a single pair of herring were to reach maturity and spawn, and if all of their progeny were to survive and spawn, and if this were to go on for a few generations, the resulting volume of fish would be beyond comprehension. In fact, if such unrestricted multiplication were to continue for a period as short as ten years, all of the seas of the earth would be filled solid with herring, all land would be submerged, and all other creatures in the world would be crowded out of existence.

USES OF THE HERRING

The extraordinary value attained by the sea-herring as a fishery product has depended in no small degree on the manifold uses to which it may be put and the numerous ways in which it is susceptible of preservation. As a fish for consumption in a fresh condition, the sea-herring does not rank high by comparison with various other marine food-fishes inhabiting the same waters; nevertheless, a perfectly fresh herring, when broiled, fried, or baked, is excellent.

An important use for fresh herring is as bait in the line fisheries for bottom species like halibut, cod, and haddock. Immense quantities are thus consumed, particularly in New England and the British provinces. The herring for this purpose are taken mostly in winter and are frozen in bulk for preservation.

The simplest method of preservation is that of drying without salt. This is a favorite method for small herring in Japan, and such fish, strung on straws or sticks, are seen exposed for sale in all parts of that country and are extensively eaten.

A favorite and simple way of preparing herring for food in America and Europe is by smoking, which is usually preceded by a short immersion in brine. Smoked fish, however, will not keep indefinitely, and the herring that enter most largely into the commerce of the world are preserved by various degrees of salting. On the coast of Maine small herrings in bulk, preserved in pickle and seasoned with spices, are known as Russian sardines.

One of the principal uses made of the sea-herring in New England is for canning as "sardines." In the same region the fish are also canned under the name of herring, and before the enactment of the present beneficent pure-food law were sometimes sold to the unsuspecting consumer as "brook trout" and "mackerel." In Great Britain a favorite canned preparation is kippered herring.

The waste parts of herring at the sardine and salting establishments are convertible into an excellent fertilizer, called

"pomace" in Maine; and in Japan, owing to lack of markets for the fish, immense numbers are caught for the special purpose of being converted into guano. Another product, usually made in connection with fertilizer, is oil, which has a wide use in the trades.

HERRING IN THE WATERS OF THE UNITED STATES

The herring fishery of the United States has always held subordinate rank. Although prosecuted from Puritan times and attaining great value, it has always been exceeded in importance by other fisheries in the states where the herring abounds. Owing to the distribution of the fish, Maine and Massachusetts have the most extensive fisheries, and the quantity of herring taken in the other New England states and in New York and New Jersey is very small. At no point south of Block Island does the fish occur in sufficient numbers or with sufficient regularity to support an established industry.

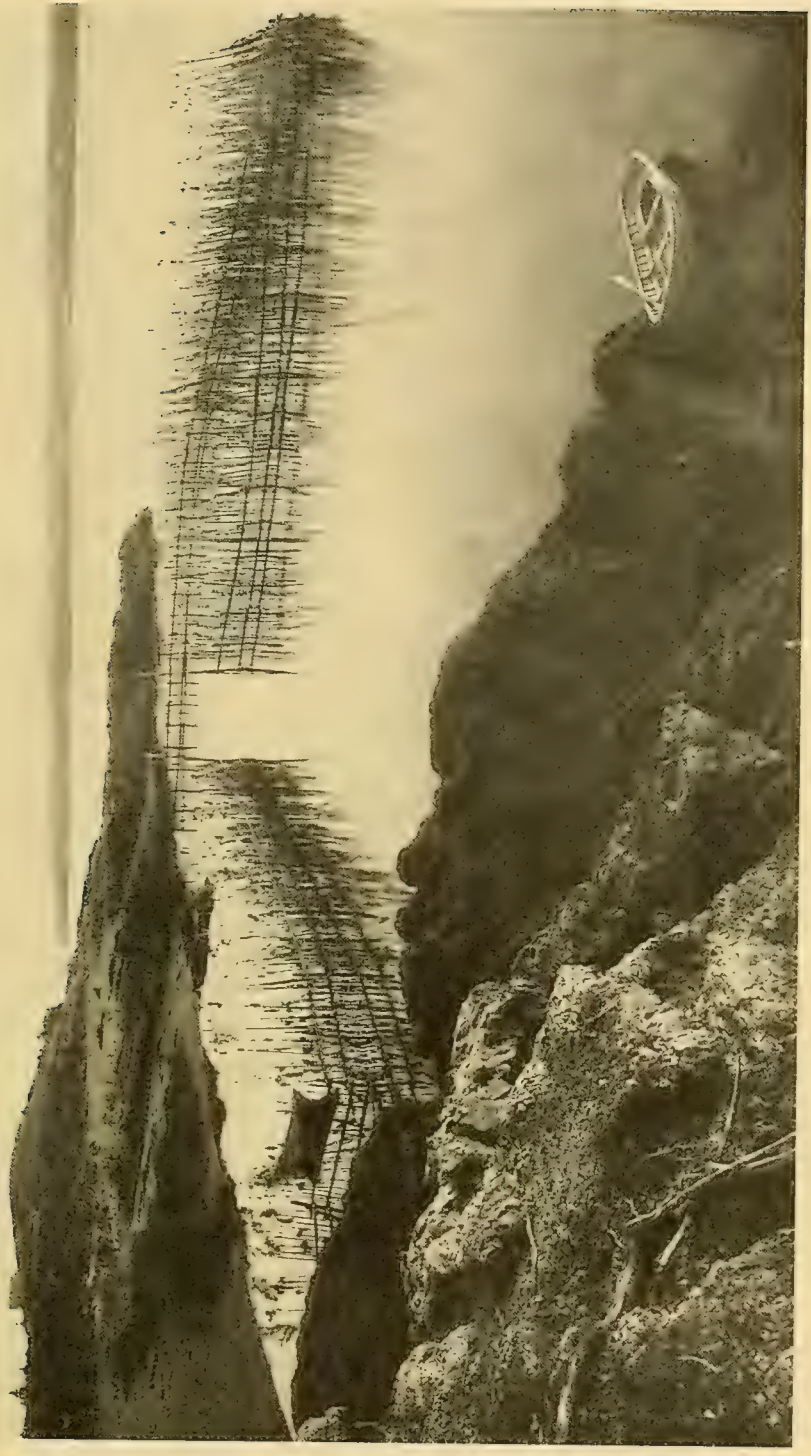
Owing to the great abundance of herring in the shore waters of Maine and Massachusetts, and of the British provinces, there has been no occasion as yet to seek the herring offshore, and hence the American fishery differs markedly in methods from the European. The oldest, and for a long time the most common, manner of fishing for herring is torching—a method learned from the aborigines. Up to about 1820 herring were caught in no other way on the eastern Maine coast. Torching depends on the well-known instinct of herring and other fishes to seek and follow a light, and is carried on with very simple apparatus. Projecting over the bow of a boat propelled by oars is a small iron basket, in which a fire of birch bark or other highly combustible material is kept burning while the fishing is going on. As soon as darkness comes on, the boat is rowed to the fishing grounds, one man steering, one man standing in the bow with a large dip-net. As the herring gather in little bunches in front of the light, they are readily caught with the dip-net, and sometimes fifteen to twenty barrels may thus be taken in a few hours. This method is followed chiefly in Passamaquoddy and Ipswich bays.

THE HERRING ARE CAUGHT PRINCIPALLY IN WEIRS

Gill nets, haul seines, and purse seines are more or less extensively employed for herring on various parts of our coast, but the characteristic apparatus in the region of most important fishing is the brush weir, which came into use about 1820 and for many years has been the principal means of taking herring in Maine, New Brunswick, and Nova Scotia, being particularly important in Passamaquoddy Bay and its tributaries. The brush weir is an aboriginal fishing device in all parts of the world, and variations in structure are numerous; but its essential feature is an inclosure made of brush, located on the shore, on a bar, between the mainland and an island or between two islands, into which the fish wander and from which they are prevented from escaping by their inability to find the exit, by the fall of tide, by the closing of the entrance, or by peculiarities of construction.

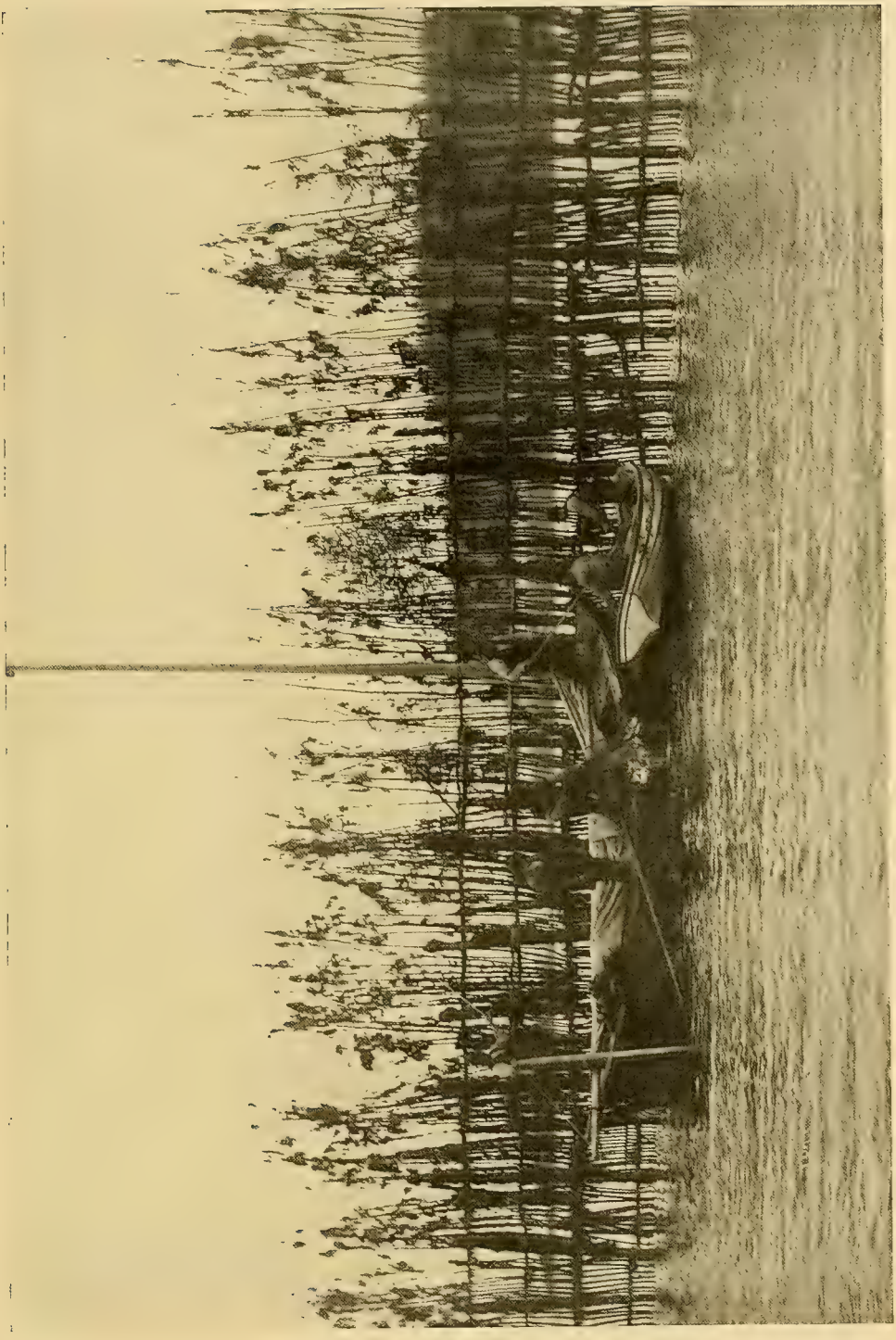
The herring brush weirs of the northeast coast are very substantially built and some are of large capacity and of considerable value. The stout stakes or posts are driven into the bottom at close intervals, or, in case the bottom is rocky, are attached to large stones, and this framework is strengthened by heavy horizontal stringers. The portion below low-water line is closely woven with branches of trees running horizontally, these being pushed to the bottom by means of a forked stick. The upper part of the weir is of loosely woven brush extending vertically two or three feet above high water. As the average tidal movement is twenty feet, and in spring nearly thirty feet, the amount of material required is considerable. Some weirs are mere semicircular inclosures, while others are provided with leaders or wings or both.

The weirs are always fished at low



A BRUSH WEIR ON THE COAST OF MAINE FOR CATCHING HERRING (SEE PAGE 704)

A VIEW OF A BRUSH WEIR AT LOW TIDE



GATHERING THE CATCH IN A BRUSH WEIR ON THE MAINE COAST (SEE PAGE 704)

tide, as then the herring are concentrated and may be more readily secured. The fishermen enter the weirs in boats, set a seine and haul its ends together, and then take out the fish with huge dip-nets. In some places the fish are left dry by the receding tide, and may be gathered by hand or with pitchforks. From 200 to 400 brush weirs are operated in waters adjacent to the international boundary between Maine and New Brunswick. They supply herring for bait, smoking, salting, and canning, and often yield very large profits to their owners. The unit of measure in this fishery is the hogshead, holding fifteen bushels, and many hundreds of hogsheads—sometimes several thousand—may be taken in a single weir in the course of a season.

$20,000 WORTH OF HERRING CAPTURED BY ONE WEIR

Upward of $20,000 has been received for the herring taken in one fortunately located weir, and there is a record of a weir on the Canadian side of Passamaquoddy Bay which was leased by Americans at an annual rental of $2,000, with a bonus of $3 for each hogshead of fish caught; yet, notwithstanding this seemingly exorbitant price, the lessees, before the close of the first season, were able to pay three years' rental in advance, owing to the large catch and high prices of small herring.

The prosperity, if not the very existence, of the herring weir fishery on the northeast coast depends on the presence of a large number of canneries at Eastport, Lubec, and other places on or near the Maine border, where herring are converted into "sardines." Weirs have also been constructed along the central and western districts of Maine in order to supply raw material for canneries and smoke-houses, and large catches are often made at points remote from the center of the herring industry. It is recorded that in October and November, 1908, a brush weir in the Bagaduce River near Castine took 20,000,000 small herring—a quantity so large that no local market could be found and the catch had to be sent to places as far eastward as Lubec.

THE AMERICAN "SARDINE"

The most valuable branch of the American herring industry is the canning of small herring under the name of "sardines." The business began in 1875, preceded by six or seven years of experimental work, and has continued up to the present time. The factories are located at suitable points along the entire Maine coast, but are most numerous on or near the eastern boundary, for reasons elsewhere stated. These factories give employment to many thousand men, women, and children; utilize immense quantities of herring that would otherwise find little market, and produce a wholesome food that for many years was marketed largely under French labels, but is now sold under its proper name and on its own merits, with a resulting improvement in quality.

The most valuable herrings for canning are the young, from three to five inches long, suitable for packing in "quarter" cans. The demand for these has at times been so active that fabulous prices—far beyond the real worth of the fish—have been paid. As much as $100 per hogshead was given one season, and a price of $30 per hogshead has not infrequently prevailed; but, on the other hand, the price has often fallen to $2 and has not averaged more than from $5 to $8. Herring of larger size are put up in oil, mustard, and tomato sauce in "half" and "three-quarter" tins, but the chief use made of the larger fish is for smoking. The Maine coast is dotted with herring smoke-houses, some independent, others in connection with canneries, and several million boxes of delicious smoked herring are there placed on the market each season.

The New Englanders have not been content with the supplies of herring obtainable from home waters, but have for many years engaged in a herring fishery and trade on the shores of the Canadian maritime provinces and of Newfound-

land. This business has been conducted mostly in winter, when the fishing vessels were otherwise idle, when the fish were schooling in the waters of the neighboring provinces, when there was a scarcity on our own shores, and when there was a good demand for herring for use as bait in the line fisheries. For this purpose our vessel fishermen resorted to various regions and engaged in the business in various ways, depending on local conditions, sometimes catching the herring themselves, sometimes hiring the provincials to fish for them, sometimes buying outright the herring already caught and awaiting a purchaser. The principal localities thus visited by our vessels were Passamaquoddy Bay and other waters near the mouth of the Bay of Fundy, the Magdalene Islands, and the treaty shores of Newfoundland. At present only the last-named region is concerned in this trade.

TROUBLES WITH NEWFOUNDLAND AND GREAT BRITAIN CAUSED BY THE HERRING FISHERIES

Some of the most serious international questions that have arisen in American history have been due to the operation of our herring fishermen in the waters of Canada and Newfoundland. The difficulties grew out of ambiguities in the Treaty of 1818 between the United States and Great Britain, and have continued, with violent exacerbations, up to the present moment; for the Treaty of 1818 has remained the chief instrument defining the rights of the American fishermen in British North American waters, and it has never been construed in a way satisfactory to both governments. It is very likely that had the controversy been between the mother country and her principal daughter it would have been amicably settled many years ago; but each of the maritime provinces as well as Newfoundland sought to have a hand in construing the treaty and in making modifications thereof to suit local conditions, and the result has been what would naturally have been expected. Fortunately the fishery question is now quiescent over a large part of His Britannic Majesty's North American coasts, and it is only in his oldest colony of Newfoundland that the bony herring has continued to be a bone of contention.

The recent history of this dispute is well known. For a number of years the United States government has had a representative on the ground in the person of an expert of the Bureau of Fisheries, who has remained there during the entire season for the threefold purpose of keeping our State Department informed of the condition of affairs, of advising our fishermen of their treaty rights, and of dissuading them from any attempt to violate the proper local regulations. Being in a staunch naval tug or revenue cutter, this representative has also been of material assistance to our fishermen in pulling out of the ice herring schooners that have stayed too late and been frozen in—a courtesy that has been extended also to vessels from the Canadian provinces.

The efforts of the Newfoundland government to restrict and modify the rights enjoyed by our fishermen under the Treaty of 1818 have been the subject of diplomatic correspondence between the United States and Great Britain, with the result that pending the settlement of the matter the home government has taken charge and approved a *modus vivendi* which permits greater freedom of fishery than the colonial authorities were willing to accord. Happily the entire controversy will soon be adjudicated by arbitration at The Hague.

VALUABLE HERRING FISHERIES ON PACIFIC COAST AS YET UNDEVELOPED

The herring fishery of the west coast of the United States is of comparatively minor importance but of great prospective value. The herring abounds, but the demand is limited in the regions of greatest abundance. The largest fishery is at Killisnoo, Alaska, where, in 1908, about 25,000 barrels of herring were converted into oil and guano. The manufacture of these secondary products began many years ago and for a long time was

A HAUL OF HERRING ON THE BEACH IN GASTINEAU CHANNEL, DOUGLAS CITY, ALASKA, ABOUT 1903

The Alaska herring are largely used for bait in the halibut fisheries

the only use to which the Alaskan herring was put. At other points in southeast and central Alaska the herring is utilized in fresh and salted conditions for human food and for bait in the halibut fisheries. In all the coast states there is a limited herring fishery, the most important interests centering at San Francisco.

The herring fishery of the United States at the present time yields about 130,000,000 pounds annually, for which the fishermen receive $870,000. Of this quantity about 10,000,000 pounds are obtained in Pacific waters. The manufactured herring products—oils, fertilizers, sardines, etc.—are worth several million dollars.

CANADA'S EXTENSIVE HERRING FISHERIES

The Dominion of Canada has the most extensive herring fisheries of the Western Hemisphere. All of the maritime provinces of Canada have an abundance of herring, and in all of them large quantities of this fish are placed on the market in various forms. Among all the foodfishes of Canada, the herring is exceeded in value only by the salmon and the cod. As the most abundant of the shore fishes of the eastern provinces, the herring played an important part in their colonization and has continued to be a large factor in their growth and prosperity.

It is in Nova Scotia and New Brunswick that the herring fisheries have attained their greatest development. As early as the eighteenth century large quantities of smoked herring in boxes were exported from Nova Scotia, and Lorenzo Sabine in his report to the Secretary of the Treasury on "The Principal Fisheries of the American Seas" (1853) said of the herring of Annapolis Basin:

> This fish, well smoked and of approved color, is a great luxury for the forenoon lunch and for the tea-table, and the time has been when a herring box branded 'Digby' or with the name of a well-known curer there, passed as current in our markets, without examination, as coin received at the mint.

The beautiful town of Yarmouth, Nova Scotia, remains true to its name and has for years sent to the market "bloaters" that for quality would reflect no discredit on the fish so called that originated at Yarmouth, the great herring center on the North Sea. On the shores of New Brunswick large quantities of small herring are caught, and some of these are canned locally; a very large percentage, however, are sent to the sardine factories at Eastport and Lubec.

Lying in the middle of the Gulf of St. Lawrence is a group of small, picturesque islands known as the Magdalenes, which have had an interesting history in which the herring fishery has been closely entwined. Their value consists almost exclusively in their fishery resources, chief among which is the herring; this fish resorts to the shores in immense shoals at times, and for at least 250 years has been a source of livelihood to the hardy inhabitants. Many of the fishermen are lineal descendants of those Acadians who, under De Monts and Champlain, made the first permanent settlement in New France; and up to a comparatively recent time, and doubtless to some extent even down to the present, they preserved the dress, language, and customs of their ancestors.

The tenure of these islands and their rich fishing privileges was once granted by the British crown to Richard Gridley, of Massachusetts, who in 1775 constructed the defensive works on Bunker Hill and became chief of the engineer department of the Revolutionary army. Under the Treaty of 1818 American fishermen enjoy the same fishing rights at the Magdalenes as the resident Canadians, and in former years many New England vessels resorted to these islands to participate in the herring fishery. The fish here taken are noted for their large size, and 25,000,000 pounds have been taken some seasons. In the middle of the nineteenth century as many as 150 fishing vessels from Maine and Massachusetts have sometimes been observed catching herring here at one time, but of late years the value of the islands to our fishermen has become insignificant.

A REMARKABLE VISITATION OF HERRING IN BRITISH COLUMBIA

The abundance of herring on the coasts of British Columbia has been known for many years. A herring fisherman from Yarmouth, England, has expressed the opinion that the herring fishing grounds of the North Sea cannot compare with those off the shores of British Columbia, and he reported a remarkable visitation of herring near Nanaimo recently, when the shore for two miles was knee deep with these fish, that had been crowded ashore by millions more while on their way to the spawning grounds. The provincial fishery authorities, who are well aware of the conditions of the herring fishery in England and Scotland, are convinced that the British Columbia herring can be put on the market in such a way as to command the price received for the transatlantic fish, and they see no reason why an industry worth from $5,000,000 to $6,000,000 yearly may not be established.

The herring catch of the Canadian provinces in the fiscal year 1907-8 was about 155,600,000 pounds, of which the first value was $2,225,000. Taking into consideration the immature fish utilized in the preparation of sardines, considerably more than 1,000,000,000 herring are taken annually in Canada.

NEWFOUNDLAND

The herring fishery of Newfoundland is important to that colony, but adds comparatively little to the world's supply of fish. It is chiefly noteworthy for the international complications to which it has given rise from a very early date.

The principal fishery is carried on in winter at the Bay of Islands, on the "treaty shores," and owes its success, if not its existence, to the American schooners from Gloucester which resort there every season and leave among the local fishermen a large amount of money, expended for labor and fish. In 1907, out of a total catch of 154,709 barrels of fresh, frozen, and pickled herring, valued at $406,409, American vessels or vessels chartered by Americans took to Gloucester 113,326 barrels, which were used for bait in the line fisheries of Massachusetts.

The friction that has frequently arisen over the herring fishery in Newfoundland has been due in part to ambiguity in the phraseology of the Treaty of 1818 and in part to the action of the colonial authorities in making the broad provisions of the treaty subordinate to local regulations. The effort to negative the treaty rights of American fishermen became more pronounced after the failure of Newfoundland to secure reciprocity with this country, and recently necessitated the interference of the mother country.

THE HERRING WAS LARGELY RESPONSIBLE FOR CHARLES I'S TROUBLES

For many centuries the herring has been the object of extensive fisheries in England and Scotland, and in recent years has attained greater importance than ever before. In both England and Scotland the fish has figured in history more than any other water creature, and has not only been of inestimable economic importance, but has had noteworthy influence on national affairs.

The prosecution of the herring fishery and trade has been considered not beneath the dignity of nobility and royalty. Fitz-Greene Halleck tells us that

> Lord Stafford mines for coal and salt,
> The Duke of Norfolk deals in malt,
> The Douglas in red herrings.

In 1677 the Duke of York and other personages of rank formed a corporation, called "The Company of the Royal Fishery of England," for the purpose of carrying on the herring fishery in the North Sea. They built a fleet of Dutch "busses" and manned them with Dutch fishermen, and then were bankrupted by the capture of their vessels during a war with France. In 1720 some two thousand of "the principal gentlemen of Scotland" formed a company for herring fishing, but were quickly disrupted, leaving a mournful lot of stockholders. In 1750 the Prince of Wales became president or

THE HERRING FLEET AT YARMOUTH, ENGLAND

governor of a herring fishery company with a capital of £500,000, whose members "were among the first men in the kingdom," one of the promoters being General James Oglethorpe, founder of the State of Georgia. Stock was taken with eagerness, vessels were built quickly, and efforts were made to learn the secrets of the Dutch methods of curing herring; but the company soon suspended and its failure cast on the English herring fishery an odium that continued for a long time.

It is a matter of great historical interest that the herring fisheries should have been a prime, and perhaps the most important, factor in the overthrow of Charles I, whose attitude toward the development of home and colonial fisheries was most unreasonable and unfortunate. At a time when the Dutch herring fishery had attained such magnitude and importance that it was regarded as the "right arm of Holland," and when the sturdy Dutch fishermen were pursuing their lucrative calling under the encouragement of their government, the English people were chafing under the grievous restrictions imposed, by royal approval, on all who desired to engage in fishing anywhere off the American coast between the fortieth and forty-eighth degrees of north latitude. This effort on the part of the crown to interfere with the cherished privilege of "free fishing" had begun under James and was bequeathed to Charles, and was perhaps the first in the series of far-reaching differences that sprung up relative to the prerogatives of the crown as against the rights of the subject. At the same time there was another restriction placed on the fishermen at home. When James ascended the throne of England his navy consisted of but thirteen vessels, and Charles succeeded to a war fleet but little stronger and utterly inadequate to cope with the navy of the Dutch or French.

After Charles had been successfully opposed by the Commons in his plan to have no fishing conducted on the American shores except by permission of the company of "noblemen, knights, and gentlemen," known as the Council of Plymouth, he levied "ship money" on the fishing and mercantile vessels at home

A STREET IN YARMOUTH, ONE OF THE GREAT HERRING PORTS OF THE WORLD, WHERE THE HERRING FISHERMEN LIVE

in order to build up his navy, with the distinct object of breaking up the Dutch herring fishery on the shores of England and driving the Dutch from "the four narrow seas" over which England claimed jurisdiction. At the expense of the fisheries and navigation, Charles finally fitted out the largest war fleet England had ever had and succeeded in his purpose so far as the Dutch were concerned, but the levying of "ship money" stirred up civil war at home and Charles paid the extreme penalty.

THERE HAS NEVER BEEN A FAILURE IN THE HERRING FISHERY OF YARMOUTH

Grimsby, Lowestoft, North Shields, and Yarmouth, the important English fishing centers on the North Sea, have great interests in the herring fishery. At Grimsby, the world's greatest fishing port, and North Shields the herring is overshadowed by the bottom fish caught with beam-trawls, but at Lowestoft and Yarmouth the herring predominates. The fishery at Yarmouth, which may be taken as a type, is carried on with steam and sail vessels called luggers, having a crew of eleven men and carrying, as means of capture, 200 gill-nets costing $10 each. These nets are 30 yards long and 20 yards deep, the average size of the mesh, bar measure, being equal to a shilling piece. When fishing begins the nets are tied together and the entire complement is shot at one time.

As the water is thick for fifteen or twenty miles off Yarmouth, fishing may be done at any hour of the day or night, but the best times are about sunrise and sunset. Fish are not left long in the nets unless storms prevent hauling. Some vessels land their fish fresh, others dry-salt their catch at sea and store it in compartments in the hold. A vessel may leave port, set nets, make a catch, and be back home the same day, or it may remain out for two weeks. There has never been a failure in the herring fishery of Yarmouth, and the thousands of persons in this quaint town who are dependent on the herring have few of those apprehensions that come to most people whose welfare is contingent on the uncertain harvest of the seas.

FIGURES SHOWING THE MAGNITUDE OF THE HERRING FISHERY OF SCOTLAND

At the present time the herring fishery of Scotland exceeds in magnitude that of any other country, being about 50 per cent more extensive than that of England, which ranks second. In 1907, when the yield surpassed any previous year, the catch exceeded 630,000,000 pounds, and the fish, if placed end to end, would have extended more than 8,000 miles. The chief centers of the industry are the Shetland Islands, Fraserborough, Peterhead, and Aberdeen. The Scotch fishery, like the English, is undergoing a radical change, consisting in the elimination of sailing vessels and the more extensive use of steamers, which are yielding a much larger proportion of the catch this year. In 1907 the number of steam vessels was about 500 (an increase of 85 per cent over 1906), valued, with their gear, at $6,000,000.

The quantity of gill-netting set for herring in the waters adjacent to the Scotch coasts is almost incredible, and it is difficult to understand how, with the fishing going on day after day for months, any considerable number of fish escape. The fact that the fishery has continued so many years without impairment indicates the wonderful prodigality and remarkable recuperative powers of nature. The gill-nets used by the Scotch in 1907 if made into a band one yard wide would reach three and a half times around the earth and their actual area exceeded 48 square miles.

The fishery is divided into three sections in the official reports, but these are not sharply defined as at present conducted, although doubtless quite distinct originally; thus the "great summer fishery" extends from July 1 to December 31, the "early summer fishery" continues from April to June 30, and the "winter fishery" is conducted in January, February, and March.

The run of herring on the coasts of Scotland attracts fishermen from all over

western Europe and often results in the most heterogeneous aggregations imaginable. Local authorities of the ports adjacent to the fishing grounds have their hands full in order to provide for the proper housing, feeding, sanitation, etc., of a tenfold increase in population during the short period of a "run." I may cite from the report of the Scotch Fishery Board for 1907 the case of a sudden influx of population at Balta Sound, in the Shetland Islands:

> The normal population of Balta Sound is less than 500, but at the beginning of June, during a fairly successful season, this will have increased to about 10,000 persons, and, in addition to the purely Shetland element in this population, there will probably be a fleet of fishing vessels from the east and west coasts of Scotland, steam drifters from England, sailing craft from the Isle of Man and the north of Ireland, and 'booms,' luggers, and steam drifters from France, Belgium, Holland, Germany, Denmark, Sweden, and Norway—the number and variety of the various craft, the picturesque and characteristic garb of the fishermen of different nationalities, and the babel of various tongues forming a scene probably unparalleled at any other fishing port in the world except Lerwick. Notwithstanding this large addition to the population, it speaks volumes for the law-abiding nature of those engaged in the industry that it has never been necessary to augment the staff of police usually employed.

When a herring vessel arrives in port the fish are lifted out of the hold in baskets and spread on deck, where they are counted into baskets by hand, 100 fish to a basket. These baskets are then passed over the rail to the dock and emptied into large, peculiarly shaped baskets holding 500 fish, arranged on the dock in lines or tiers of 20 baskets each. The fish are heaped in 10 piles over the edges of adjoining baskets to facilitate counting. A line of the large baskets constitutes a last, which is the unit of measure in the herring trade. A last represents about 1½ tons of herring, or theoretically 10,000 fish, but as a matter of fact 13,200 fish of any size, as 132 fish are called 100 in counting. Herring are sold at public auction by lasts. The buyer puts his card or tag on the first basket of the tier, and his drayman comes shortly afterwards and takes the fish to the pickling-house or smoke-house. Sometimes, at the height of the fishery, as many as 1,000 lasts (or 3,000,000 pounds) have been landed and sold in one day at Yarmouth and other ports; and whenever the catch is large the wharves present scenes of great activity and excitement.

THE "YARMOUTH BLOATER"

Considerable quantities of herring are consumed in a fresh condition, and the celebrated "whitebait" of England consists almost exclusively of young herring; but the herring fishery and trade owe their importance to the herring that are preserved in various ways. Household names in Great Britain applied to the different kinds of cured fish are "bloater," "kippered herring," "white-cured herring," and "red herring." The "bloater," especially the "Yarmouth bloater," has a world-wide reputation, either in its original form or as now prepared in America and Canada, and it is the favorite herring for local consumption. In the United States a bloater is a large, lightly smoked herring; but in Great Britain a fish of any size may be a bloater, which may be defined as an unsplit, lightly salted, lightly smoked herring intended for immediate consumption. Among the varieties of preserved herring none rank higher than the "kippered" fish, the essential characteristic of which is that before being salted and smoked they are split and eviscerated. "White-cured herring" give to the English and Scotch herring trade the great extent it has attained, as such fish, after being gutted through the gill cavity and heavily salted, are packed in barrels and sent all over the world.

A very elaborate set of regulations for preparing "white-cured herring" has been drawn up by the Scotch fishery board, and each barrel of salt fish is officially guaranteed by a mark or brand showing size, quality, spawning condition, etc., of the fish. "Red herring" are a special grade of heavily salted fish that are smoked for a long time, to give them a rich brown color, and are intended chiefly for the Italian, Grecian, and general

A PART OF THE HERRING FLEET AT LOWESTOFT

ON BOARD A LOWESTOFT DRIFTER

EMPLOYÉS OF AN ENGLISH HERRING FIRM

A GANG OF HERRING CURERS AND PACKERS

Mediterranean trade. There are few kinds of preserved fish which have greater thirst-producing properties; and they became favorites at home at a very early date, and are frequently referred to in the poetic literature of the sixteenth and seventeenth centuries, when it was said of many people that they were "neither fish, nor flesh, nor good red herring."

The handling, smoking, curing, packing, and shipping of herring give employment to a veritable army, a large proportion of which are women. In the Scotch herring industry the shoresmen are drawn mostly from the Highlands and the Hebrides and number fully 50,000, and the curing business of both England and Ireland is dominated by Scotchmen.

The herring fishery of England and Wales in 1906 yielded about 328,000,000 pounds of fish, for which the catchers were paid $6,595,930, the largest price ever received in the history of the fishery. As showing the preponderating importance of the North Sea as a fishing ground, it may be noted that while the south and west coasts of England produced 25,000,000 pounds of herring, the east coast is credited with 303,000,000 pounds. The best year in the history of the Scotch fishery was 1907, when over 631,000,000 pounds of herring, valued at $9,081,300, were taken by 25,000 fishermen in 5,600 vessels and boats. The quantity of herring then cured was 2,578,268 barrels, which brought the packers $13,148,385. Of the foregoing 627,100 barrels were exported to Russia and 1,186,100 barrels to Germany, about fifty per cent of the latter quantity being reexported to Russia.

The herring represents more to the Irish fishermen than any other product of the waters, and its value is nearly one-third of the entire yield of the fishing industry of the country. The fish is taken with drift-nets around the entire coast, but the largest catch is made on the east and north shores. In 1907 the output was nearly 31,000,000 pounds, for which the fishermen received over $500,000. The principal centers of the fishery are Downings Bay, Ardglass, Howth, and Donegal.

FRANCE

France is one of the great fishing nations of the world, and herring is her principal water product. It is true that the value of the French cod fishery somewhat exceeds that of the sea-herring, but nearly all of the cod are caught off Iceland and Newfoundland, leaving the herring easily the leading fish of home and adjacent waters. An established herring fishery was carried on in the North Sea by Dieppe and Rouen fishermen as early as the eleventh century. It had attained great importance by the eighteenth century, but declined during and after the Napoleonic wars.

The French herring fishery is now in a very flourishing condition and is more extensive than ever before, so that in continental Europe France is surpassed only by Holland as a producer of herring. The fishery is naturally divisible into two sections, one conducted in the North Sea and the other along the shores of the north and west coasts of France. The leading center is Boulogne, with Fécamp a close second. Other important points are Calais, Étaples, Saint-Valery-sur-Somme, Dieppe, Honfleur, Trouville, Villerville, and Étretat.

The year 1905 was the most successful recorded up to that time, and for it detailed official statistics are available. It appears that 10,880 fishermen then set their nets for the herring hosts, and that more than 163,000,000 pounds of these fish were marketed. Two-thirds of the product came from the coastal waters and one-third from that greatest of all international fishing grounds, the North Sea. The substantial sum of 18,260,000 francs inured to the French herring fishermen in 1905.

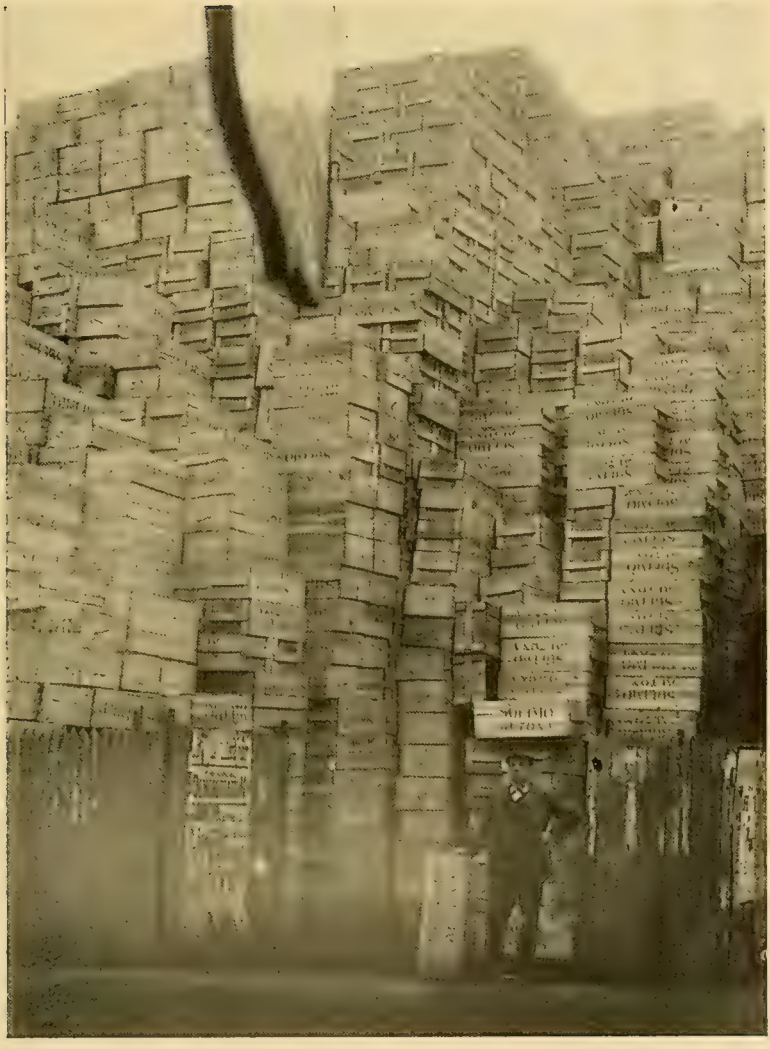
One of the most interesting and far-reaching episodes in French history happened in the year 1428 and was directly connected with the herring. The English, who were then besieging Orleans, which was held by the French, sought to

SCENE IN AN ENGLISH HERRING PACKING YARD

provide a fish diet during Lent for the investing army. The French, however, made a sortie and endeavored to intercept the supply train bringing in the coveted salted herrings. Then was fought the celebrated "Battle of the Herrings." The French were defeated and were ready to surrender the city, but at this critical point the Maid of Orleans made her initial appearance on the horizon of history and accomplished, as her first chosen task, the raising of the siege.

"THE FOUNDATIONS OF AMSTERDAM WERE LAID ON HERRING BONES"

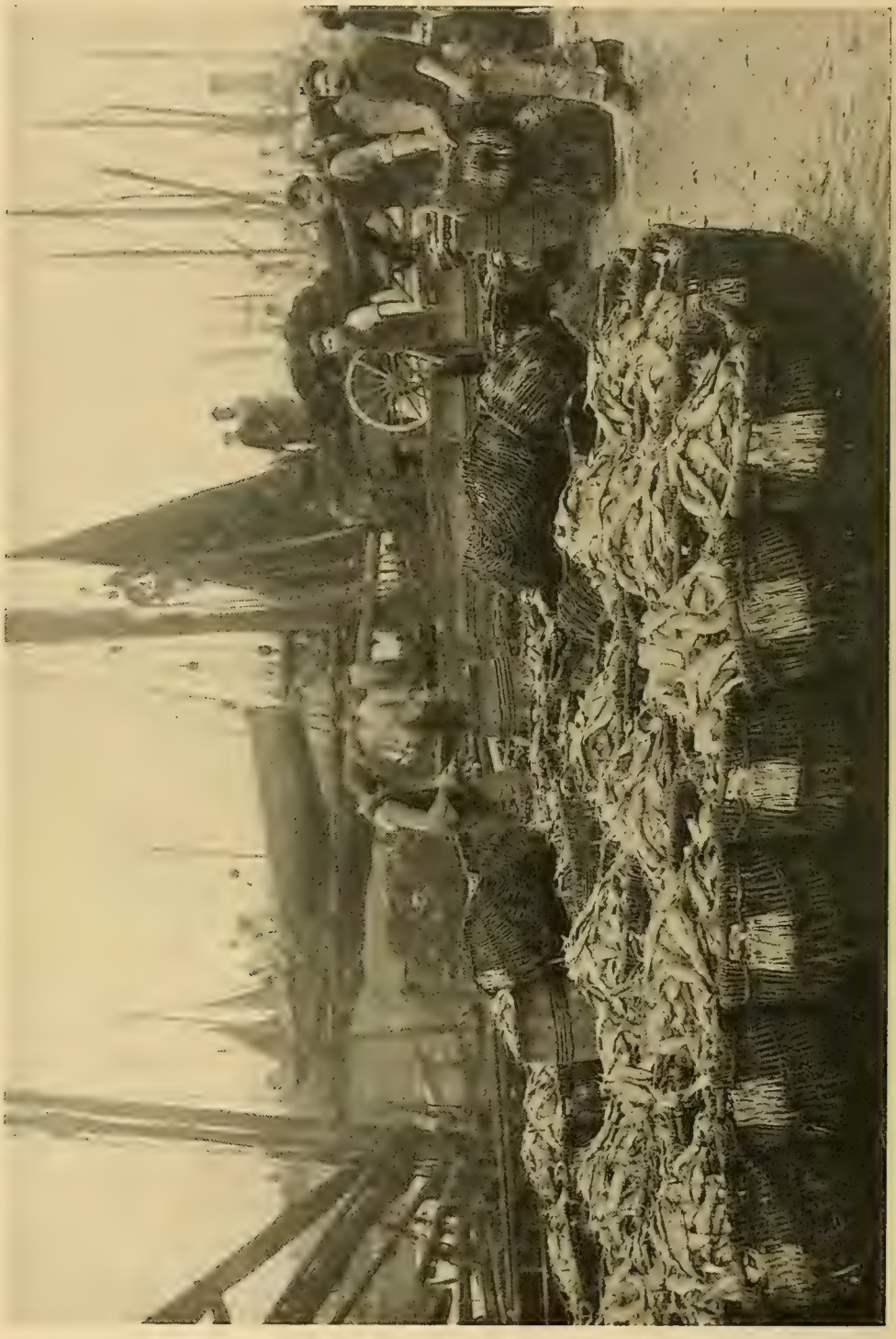
The herring fishery is inextricably entwined with the history of Holland, and in no other country has the herring been relatively so important. The greatness attained by the Dutch as a sea power several centuries ago was due directly to their herring fishery; the Dutch navy, for years the most formidable, was manned by herring fishermen, and the



A STACK OF HERRING BOXES AWAITING THE FISHERY AT A NORTH SEA PORT

tremendous foreign trade of Holland depended largely on the herring. The old saying that "the foundations of Amsterdam were laid on herring bones" might have been literally true of that place and various other Dutch ports. In the Middle Ages, when all continental Europe ate no animal food save fish during Lent, the consumption of cured fish was enormous and the demand was supplied chiefly by the Dutch.

Only a few figures have been preserved to show how extensive the herring fishery was in medieval times. It is known, however, that at one period in the fifteenth century there were 50,000 Dutch herring fishermen, and between 200,000 and 300,000 people engaged on shore in building vessels, making nets, constructing barrels, and handling the catch; there were also many thousand men on the vessels that transported the



LANDING THE HERRING CATCH AT LOWESTOFT

SORTING AND PACKING THE CATCH AT LOWESTOFT (SEE PAGE 716)

SELLING A SMALL LOT OF FISH AT AUCTION

salt herring to ports on the Mediterranean and Baltic seas.

Holland has maintained her supremacy in herring among her continental neighbors, but in recent times has been surpassed by England and Scotland.

Vlaardingen, situated on the Maas a few miles below Rotterdam, is the center of the herring trade. There the herring boats fit out, there they land their catch, and there are the substantial houses in which the fish are prepared for shipment. Both steam and sail vessels are employed in the fishery, the former chiefly in the offshore operations in the North Sea. The cotton gill-nets used are 360 meshes deep and 720 meshes long, and are so arranged with corks and leads that they sink six feet below the surface. As from 80 to 150 nets are set at one time, it appears that the total length of netting used by each vessel is from 1½ to nearly 3 miles.

In 1905 the Dutch herring fishery yielded $4,447,470. This sum represented 114,492,000 herring caught in the Zuyder Zee and 608,081 barrels of salted herring caught in the North Sea. The aggregate weight of the product was over 200,000,000 pounds.

That procedure which, more than anything else, has given to the Dutch herring their well-merited reputation for quality is the dressing and salting of the fish immediately after the nets are hauled on board the vessels. Provided with a short knife, tied to the third and fourth fingers of the right hand by a string attached to the handle, the fishermen thrust the knife through the gill cavities of the herring, and in withdrawing it cut and bear away the gills, heart, esophagus, and pectoral fins. The opening of the large blood-vessels leads to free bleeding, and as a result the flesh becomes pale, whereas in the Scotch fishery the cutting is done after the blood has clotted, and the flesh remains dark reddish. The Dutch fishermen become very expert in cutting, and some of them can cut 1,200 fish an hour. As soon as the herring are thus dressed they are salted in barrels and stored on board until the end of the trip.

It is a matter of some local interest to know that many of the barrels in which the Dutch pack their pickled herring and send them all over the world are made from oak staves imported from New York, Baltimore, and Newport News. The hoops are made from willow trees grown on the dikes.

Some very ancient customs connected with the herring fishery are still observed in more or less modified form. The landing of the first haul of herring in a town was the occasion for a general holiday and merrymaking. The fish dealers in some places used to offer a ducat apiece for the first fish caught, and the first herring of the season was placed in a decorated car at The Hague and taken in pomp to the king, who presented 500 florins to the fortunate fishermen.

NORWAY

While the cod overshadows all other fishes of Norway, the herring ranks second in importance, being taken in larger quantities and having greater value than all the remaining water products combined. The fish is found along the entire coast, and is caught for market from the Skager Rak to North Cape, but the principal fishing is in the districts of Stavanger, Bergen, Romsdal, Trondhjem, and Nordland.

Herring fishing on the Norwegian coast has a very romantic aspect. The fjords and bays where the fish are found are picturesque in the extreme, and most of the boats are the old Viking type.

The Norwegians classify their herring as spring herring or spawn herring, summer herring or fat herring, and brisling or small herring, the aggregate catch and value of these being in the order named.

In capturing herring set gill-nets, drift gill-nets, and sweep-seines are used. The usual apparatus for the North Sea and other open waters is the drift-net. Sweep-seines and chains of set-nets are often employed to barricade schools of herring that have wandered or been scared into a cove or an arm of a fjord. The most interesting type of net in the Norwegian herring fishery, however, is the "synkenot," a piece of netting about

250 feet square which is lowered to the bottom while each corner is connected with a boat. Large catches, particularly of fat summer herring, are made with this apparatus.

The Norwegian herring fisheries vary considerably from year to year, but show no striking changes in the past decade. Some seasons the fishermen have numbered less than 20,000 and others as many as 50,000. The catch in 1905 was 291,293,000 pounds, for which the fishermen received $2,473,300.

SWEDEN

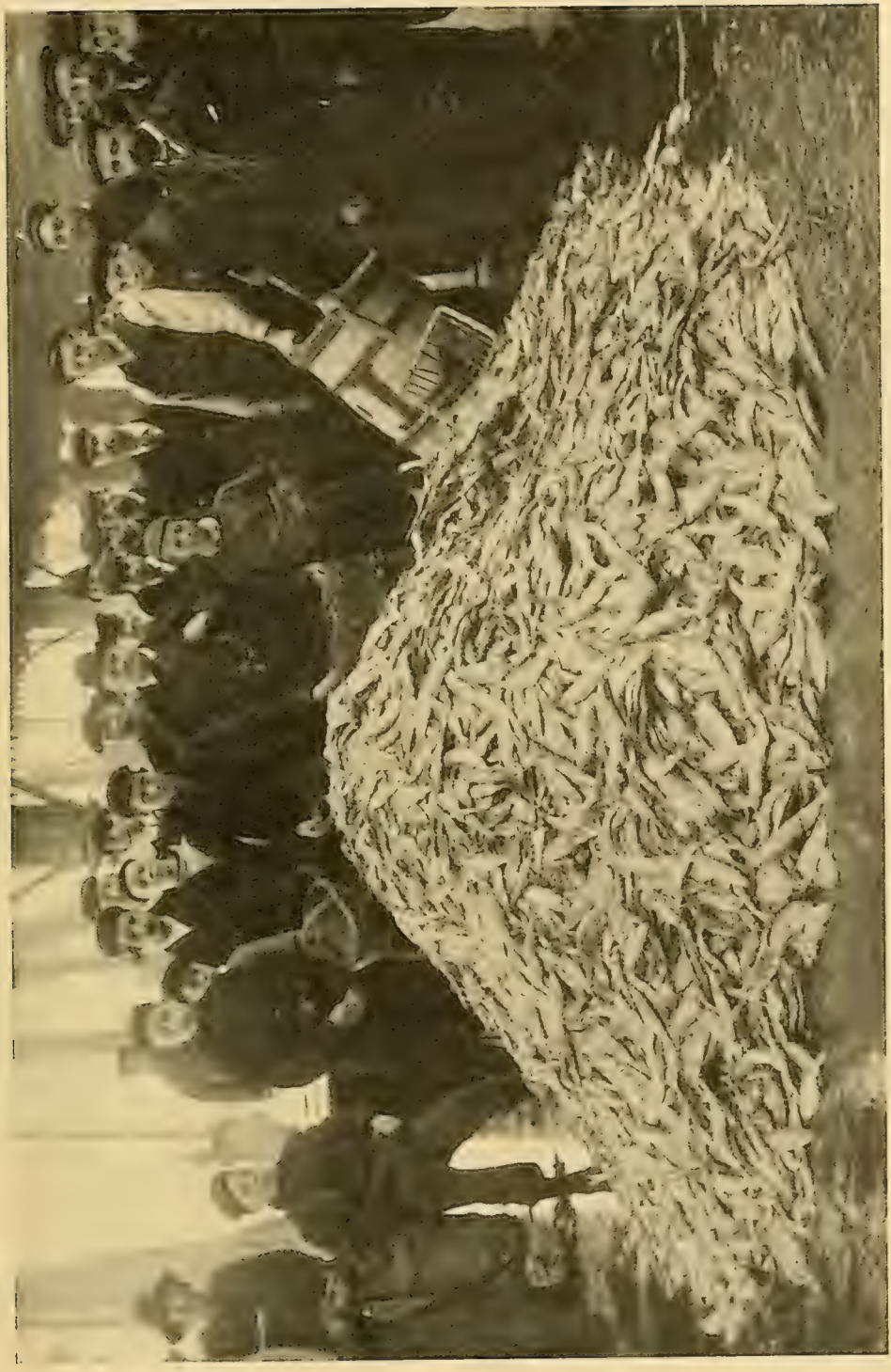
The herring resorts to all the coasts of Sweden, but is most abundant on the western seaboard, in the Skager Rak and Kattegat, becoming less numerous in the Baltic, and still less so in the Gulf of Bothnia. The periodicity in abundance to which the fish is liable in Scandinavian waters has been particularly noteworthy in Sweden, and has meant a great deal to the coastwise districts of that country, where fishing is the leading industry and the herring the principal fish.

In the archipelago forming a part of the districts of Göteborg and Bohus a herring fishery of great importance sprang up at a very early date. Prior to the sixteenth century no records were kept, but as both church and state derived an income from herring tithes and taxation, it has been possible to learn that a fishery existed there as early as the beginning of the eleventh century. It has likewise been established that even at that time, when fishing could not have had any possible influence, there were long series of years when the herring were practically absent from the region, and such times of scarcity have alternated with years of abundance up to the present day. The periods of abundance have lasted from 20 to 80 years, and the periods of scarcity from 60 to 70 years, during the past four centuries. From 1747 to 1808 the herring was present on this coast, and the great prosperity enjoyed by Göteborg in the latter part of the eighteenth century was directly dependent on the herring fishery; but during the next 68 years the herring failed to appear and distress and financial loss resulted. A Swedish clergyman has given some idea of the extent of this calamity, when the herring had been absent less than 25 years. Writing in 1831, he said:

> He who knew the coast of Bohuslän twenty-five years ago and now sees it again will scarcely be able to refrain from tears. Then it presented an imposing appearance. From the sea itself rose massive walls and pillars supporting immense salting houses and oil refineries. Farther inland rich warehouses and busy workshops might be seen, as well as palatial residences of the merchants and neat cottages of the fishermen and workingmen. The coast was crowded with a busy throng and the sea studded with sails. Every night it looked as if there were a grand illumination, many thousand lights shining from the windows and from the numerous lamps along the quays, and being reflected in the waves. Everything was life and bustle, and tons of gold exchanged hands. Now nothing is seen but ruins, only here and there a dilapidated fisherman's cottage, awakening melancholy thoughts in the visitor. Would that those glorious times for which thousands are sighing might return.

In 1877 the herring returned, and immediately there sprang up a great fishery which has continued to the present time. The period of maximum production was 1890 to 1895, since which years there has been a considerable decline, which will doubtless terminate in another withdrawal of the herring from this coast.

It has been possible only in recent years to offer a rational and adequate explanation of the periodical abundance of the herring on the Swedish shores, although for centuries all kinds of theories have been advanced. As the result of careful studies of the physical and biological conditions prevailing in the North Sea and its tributaries, Scandinavian scientists have reached the conclusion that the cause of the wonderful fluctuations in the herring is to be found in the presence or absence of coastal bank-water coming in from the North Sea and giving to the shore waters of Bohuslän certain peculiarities. When, under the influence of winds or currents, or both, this new mass of water containing food and having the proper density sweeps to the east-



A BIG HEAP OF FISH JUST UNLOADED FROM A NORTH SEA DRIFTER

PILES OF HERRING READY FOR PACKING; LOWESTOFT

A FEW BARRELS OF SALT HERRING AT A NORTH SEA PORT

The barrels of salt herring packed annually in Scotland would, if placed end to end, extend 1,500 miles, or half across the United States

ern side of Kattegat, the herring go with it and a fishery follows.

Various forms of gill-nets and seines are employed, the most productive apparatus being drift gill-nets. About 1895 fully 10,000 fishermen were engaged in the Swedish herring fishery, and fish to the value of more than $1,000,000 were caught. Ten years later the herring were much less abundant, and the catch fell to $475,000.

OTHER EUROPEAN COUNTRIES

Russia has a fishery for the sea-herring in the White and Baltic seas, but no reliable information relative to the extent of the industry is available. The principal catch of herring is made in the Caspian and Black seas, the species sought being large and similar to our shad.

Belgium's interest in the herring fishery at the present day is comparatively trivial; but in ancient times a large part of the coastwise population made a living by catching and salting herrings. As early as the twelfth century the Flemish herrings were renowned, and the Flemish fishermen visited the coasts of England, Scotland, Norway, and Denmark, to take herring in their drift-nets when for any reason the fish failed to visit the home shores. So valuable was the herring that the fishermen sometimes cruised as far as Iceland when the fish were scarce in nearer waters. The Flemish herring fishermen became particularly prosperous when Edward III of England permitted them to sell their fish in his realm. Today the Belgian herring fishery is restricted to the towns of La Panne and Coxyde, from which about 100 small sloops operate. Their catch in 1906 was worth only $53,950.

Denmark has herring fishing in the North Sea, Skager Rak, Kattegat, Lim Fjord, and Baltic Sea; but by far the most extensive industry is in the waters east of the Skaw, chief of which is the Kattegat. Between 100 and 200 million herring are taken annually, and in a recent year the value of the catch was $619,000.

The herring fishery of Germany is of ancient origin. While there are minor interests in the Baltic Sea, the industry has always centered at Emden, at the mouth of the Ems, and been supported by the shoals of fish in the North Sea. After years of cessation, the fishery sprang up again at Emden in 1872, owing to the advent of a Dutch firm from Vlaardingen, and the growth of the business there has been steady. At present upward of 150 German vessels, including a number of steam luggers, are now engaged in the North Sea fishery, and the annual catch is from 40 to 50 million pounds, worth about $1,000,000.

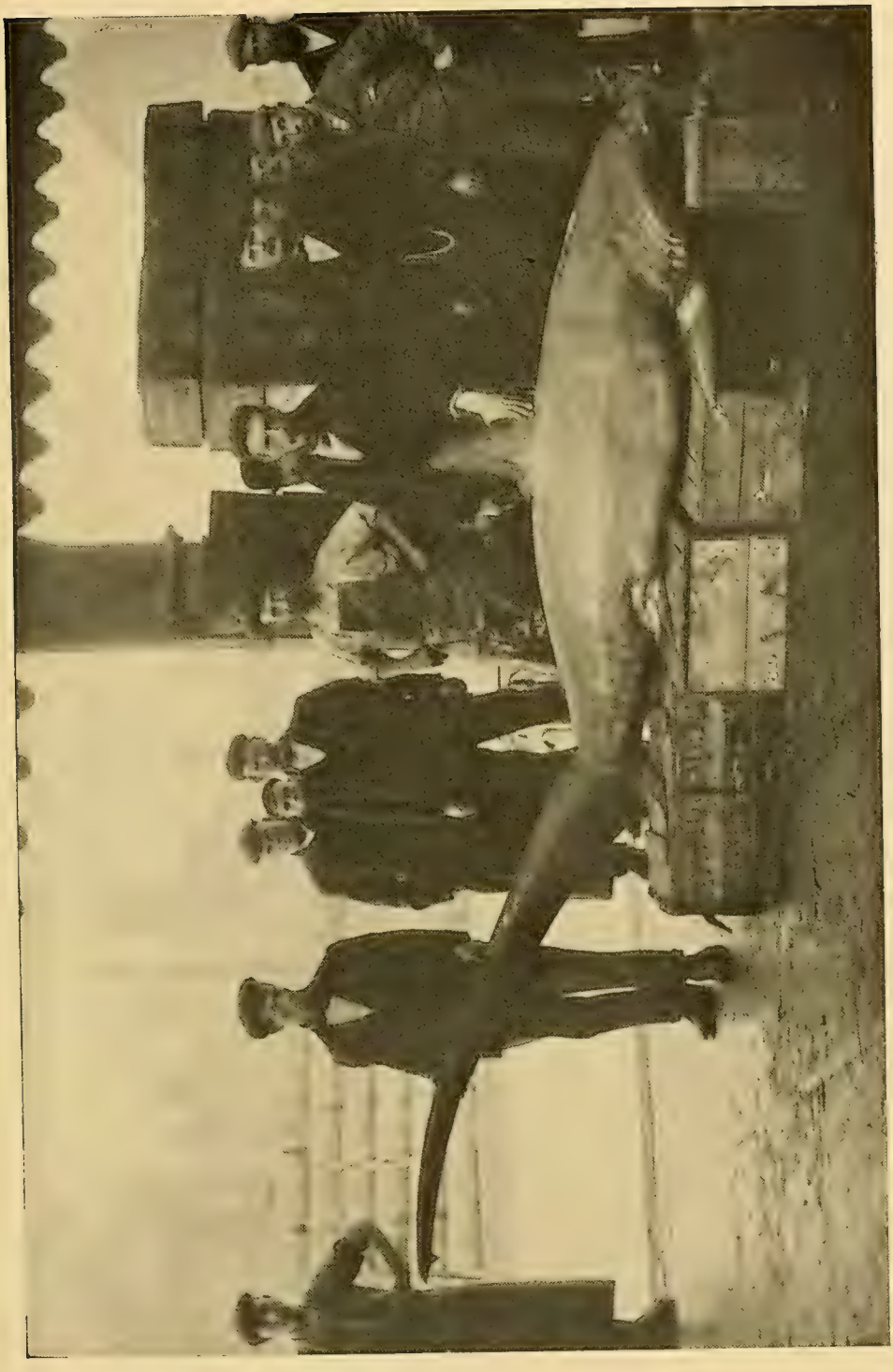
JAPAN

In this country, whose fisheries are comparatively more important than in any other and actually more valuable than in any except the United States and Great Britain, the herring is easily the most valuable product of the waters.

The fish occurs in immense shoals on the northern coasts of Japan, from Sakhalin to the northern parts of Honshu, being particularly abundant and caught in largest quantities in Hokkaido.

The fishery is conducted in spring, and is prosecuted with gill-nets, seines, and pound-nets. In Hokkaido, where 16,000 fishermen engage in this branch, most of the herring caught are made into guano, owing to the immense quantities caught in a very short time and to the lack of facilities for curing or preserving in any other way. The average quantity of herring marketed in Japan annually of late years has been over 325,000,000 pounds, valued at $4,250,000, and has occasionally reached 430,000,000 pounds. In the fisheries of Hokkaido about 300,000,000 pounds of herring guano, worth $3,400,000, are prepared each year.

The acquisition of part of Sakhalin, together with the fishing privileges on the Siberian coasts secured by the Treaty of Portsmouth, has greatly increased the fishing grounds and fishery resources of Japan, particularly in cod, salmon, and herring, and the development of the new grounds that is now in progress will add



ONE OF THE MOST EXPERT HERRING CATCHERS—A THRESHER SHARK

much to the value of the herring fisheries.

TEN BILLION HERRING CAUGHT ANNUALLY

From official statistics of all of the principal and most of the minor fishing countries and from careful estimates for all of the remaining countries, it is quite evident that the sea-herrings of the North Atlantic and North Pacific oceans are easily the most important fishes in the world today, being taken in greater numbers, constituting a larger food supply, supporting more people, and yielding larger money returns than any other product of the seas.

The world's annual production of herring at the present time is about 2,495,000,000 pounds, having a value of $36,895,000 at first hands. The value of the herring as placed on the markets, in the form of salted, smoked, and canned fish, oil, and guano, is not less than $60,000,000.

Many years ago Professor Huxley estimated that three billion herring were taken annually in the North Atlantic Ocean and its arms. These figures were doubtless ultra-conservative, as they were based on an allowance of only two fish to a pound, and did not take into consideration the hundreds of millions of pounds of immature and small fish caught in all countries. From an estimate based on the present extent of the fisheries, and on the actual weight of the herring in different countries and industries, varying from less than one-tenth of a pound in the "sardine" fishery of Maine and New Brunswick to nearly a pound in the case of the largest "bloaters" in America and Europe, I have reached the conclusion that the annual destruction of herring by man at the present time exceeds 10,900,000,000 fish, or seven fish to every person in the world.

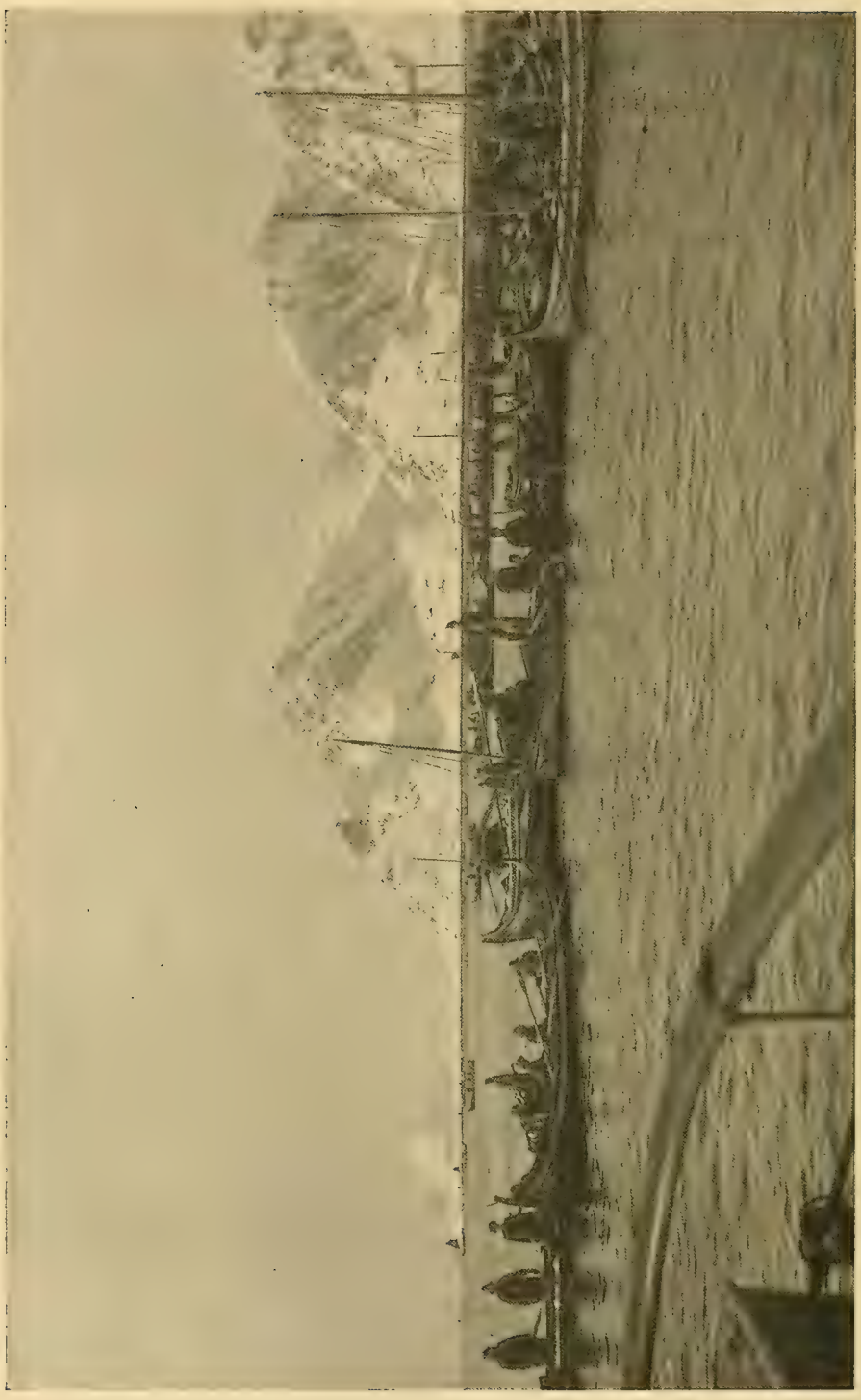
Some pains have been taken to ascertain the approximate number of people who are engaged in the herring fisheries and their numerous ramifications—fishermen proper, transporters, cleaners, packers, curers, canners, smokers, coopers, net-makers and menders, wharfingers, shippers, vessel and boat builders, and many other trades. From the best information obtainable it seems that not less than 375,000 persons are directly supported by the herring. If to these are added their families, fully 1,250,000 men, women, and children would appear to be dependent upon this fish.

WILL THE HERRING SUPPLY LAST?

The question of the perpetuity or maintenance of a species which is caught in such immense quantities has engaged the attention of governments, scientists, publicists, and fishermen for many years. One of the most philosophical minds ever enlisted in the service of fishes and fisheries was that of Thomas H. Huxley, whose well-known investigations of the herring in behalf of the British government have afforded the best basis for judging of the stability of pelagic fishes like the herring with reference to the possible effects of man's influence thereon. Huxley's researches more than those of any other person have determined the attitude of governments and fishery authorities toward the important question of legislation for the protection of the free-swimming marine fishes.

Huxley concluded that the entire annual take of herring in Europe does not represent more fish than would be contained in any one of scores of shoals existing at one and the same time. The fact that, with a few peculiar local exceptions, the abundance of herring has remained unimpaired for centuries affords ground for Huxley's recommendation that in the case of the herring, and inferentially of other species of similar habits, the best thing for the governments to do regarding the fisheries therefor is to do nothing, letting the "people fish how they like, as they like, and when they like." The destruction wrought by man is, in fact, insignificant when compared with that which must regularly occur independently of him; and, as an average thing, it is doubtful if human agencies are responsible for more than

HERRING FLEET IN A NORWEGIAN HARBOR



HERRING FISHER BOATS OF NORWAY: SMALL-NET FISHING (SEE PAGE 725)

five per cent of the annual losses to which the herring schools are necessarily liable, from whales, porpoises, seals, and other mammals; from cod, haddock, mackerel, sharks, and other fishes; from gulls, gannets, and other birds, and from the thousands of other natural enemies that begin to prey on the herring while it is still in the egg and continue their attacks throughout its entire existence.

As Huxley has shown, the basis on which the permanency of the herring schools depends is not so much the *preservation* of a certain percentage of the fish as the *destruction* of nearly the entire progeny of each female herring each year. If every mature female herring lays 20,000 eggs, a very conservative estimate, and if the numbers of herring are to remain approximately the same from year to year, then 19,998 of the progeny of every mature female must be destroyed before they reach the spawning period; for if more than two out of the 20,000 escape destruction and spawn, then more fish will be produced than are necessary for maintaining the schools.

Thus many thousand times the number of herring contained in the schools of a given region must be destroyed each year if the average size or strength of those schools is to remain the same. Huxley has summed up the case in this lucid language:

> Man, in fact, is but one of a vast coöperative society of herring-catchers, and the larger the share he takes, the less there is for the rest of the company. If man took none, the other shareholders would have a larger dividend and would thrive and multiply in proportion, but it would come to pretty much the same thing to the herrings.

ECONOMIC LOSS TO THE PEOPLE OF THE UNITED STATES THROUGH INSECTS THAT CARRY DISEASE *

By L. O. Howard, Ph. D.

Chief of the U. S. Bureau of Entomology

IT has been definitely proven and is now generally accepted that malaria in its different forms is disseminated among the individuals of the human species by the mosquitoes of the genus Anopheles, and that the malarial organism gains entrance to the human system, so far as known, only by the bite of mosquitoes of this genus. It has been proven with equal definiteness and has also become generally accepted that yellow fever is disseminated by the bite of a mosquito known as *Stegomyia calopus* (possibly by the bites of other mosquitoes of the same genus), and, so far as has been discovered, this disease is disseminated only in this way.

Further, it has been scientifically demonstrated that the common house fly is an active agent in the dissemination of typhoid fever, Asiatic cholera, and other intestinal diseases by carrying the causative organisms of these diseases from the excreta of patients to the food supply of healthy individuals; and that certain species of fleas are the active agents in the conveyance of bubonic plague. Moreover, the tropical disease known as filariasis is transmitted by a species of mosquito.

Furthermore, it is known that the so-called "spotted fever" of the northern Rocky Mountain region is carried by a species of tick; and it has been demonstrated that certain blood diseases may be carried by several species of biting insects. The purulent ophthalmia of the Nile basin is carried by the house fly. A

* From Bulletin No. 78, Bureau of Entomology, U. S. Department of Agriculture.

similar disease on the Fiji Islands is conveyed by the same insect. Pink eye in the southern United States is carried by minute flies of the genus Hippelates. The house fly has been shown to be a minor factor in the spread of tuberculosis. The bedbug has been connected with the dissemination of several diseases. Certain biting flies carry the sleeping sickness in Africa. A number of dangerous diseases of domestic animals are conveyed by insects.

The literature of the whole subject has grown enormously during the past few years, and the economic loss to the human species through these insects is tremendous. At the same time, this loss is entirely unnecessary; the diseases in question can be controlled, and the suppression of the conveying insects, so absolutely vital with certain of these diseases and so important in the others, can be brought about.

MONEY LOSS CAUSED BY MOSQUITOES

Entirely aside from the loss occasioned by mosquitoes as carriers of specific diseases, their abundance brings about a great monetary loss in other ways.

Possibly the greatest of these losses is in the reduced value of real estate in mosquito-infested regions, since these insects render absolutely uninhabitable large areas of land available for suburban homes, for summer resorts, for manufacturing purposes, and for agricultural pursuits. The money loss becomes most apparent in the vicinity of large centers of population. The mosquito-breeding areas in the vicinity of New York City, for example, have prevented the growth of paying industries of various kinds and have hindered the proper development of large regions to an amount which it is difficult to estimate in dollars and cents and which is almost inconceivable. The same may be said for other large cities near the seacoast, and even of those inland in low-lying regions. The development of the whole State of New Jersey has been held back by the mosquito plague.

Agricultural regions have suffered from this cause. In portions of the Northwestern States it has been necessary to cover the work horses in the field with sheets during the day. In the Gulf region of Texas at times the market value of live stock is greatly reduced by the abundance of these insects. In portions of southern New Jersey there are lands eminently adapted to the dairying industry, and the markets of New York, Philadelphia, and the large New Jersey cities are at hand. In these localities herds of cattle have been repeatedly established, but the attacks by swarms of mosquitoes have reduced the yield of milk to such an extent as to make the animals unprofitable, and dairying has been abandoned for less remunerative occupations. The condition of the thoroughbred race horses at the great racing center, Sheepshead Bay, Long Island, was so impaired by the attacks of mosquitoes as to induce those interested to spend many thousands of dollars a few years ago in an effort to abate the pest.

All over the United States, for these insects, and for the house fly as well, it has become necessary at great expense to screen habitations. The cost of screening alone must surely exceed ten millions of dollars per annum.

MALARIA IS STILL SPREADING OVER THE COUNTRY

The west coast of Africa, portions of India, and many other tropical regions have always, at least down to the present period, been practically uninhabitable by civilized man, owing to the presence of pernicious malaria. The industrial and agricultural development of Italy has been hindered to an incalculable degree by the prevalence of malaria in the southern half of the Italian peninsula, as well as in the valley of the Po and elsewhere. The introduction and spread of malaria in Greece is stated by Ronald Ross, and with strong reasons, to have been largely responsible for the progressive physical degeneration of one of the strongest races of the earth.

In the United States, malaria, if not endemic, was early introduced. The

probabilities are that it was endemic, and it is supposed that the cause of the failure of the early colonies in Virginia was due to this disease. It is certain that malaria retarded in a marked degree the advance of civilization over the North American Continent, and particularly was this the case in the march of the pioneers throughout the Middle West and throughout the Gulf States west to the Mississippi and beyond. In many large regions once malarious the disease has lessened greatly in frequency and virulence owing to the reclamation of swamp areas and the lessening of the number of the possible breeding places of the malarial mosquitoes, but the disease is still enormously prevalent, particularly so in the southern United States.

There are many communities and many regions in the North where malaria is unknown, but in many of these localities and throughout many of these regions Anopheles mosquitoes breed, and the absence of malaria means simply that malarial patients have not entered these regions at the proper time of the year to produce a spread of the malady. It has happened again and again that in communities where malaria was previously unknown it has suddenly made its appearance and spread in a startling manner. These cases are to be explained, as happened in Brookline, Mass., by the introduction of Italian laborers, some of whom were malarious, to work upon the reservoir; or, as happened at a fashionable summer resort near New York City, by the appearance of a coachman who had had malaria elsewhere and had relapsed at this place. In such ways, with a rapidly increasing population, malaria is still spreading in this country.

MALARIA RESPONSIBLE FOR MORE DEATHS THAN ANY PARASITIC DISEASE

It is undoubtedly safe to assume that the death rate for the whole population of the United States due to malaria is in the neighborhood of 15 per 100,000.

But with malaria perhaps as with no other disease does the death rate fail to indicate the real loss from the economic point of view. A man may suffer from malaria throughout the greater part of his life, and his productive capacity may be reduced from 50 to 75 per cent, and yet ultimately he may die from some entirely different immediate cause. In fact, the predisposition to death from other causes brought about by malaria is so marked that if, in the collection of vital statistics, it were possible to ascribe the real influence upon mortality that malaria possesses, this disease would have a very high rank in mortality tables.

Writing of tropical countries, Sir Patrick Manson declares that malaria causes more deaths, and more predisposition to death by inducing cachectic states predisposing to other affections, than all the other parasites affecting mankind together. Moreover, it has been shown that the average life of the worker in malarious places is shorter and the infant mortality higher than in healthy places.

But, aside from this vitally important aspect of the subject, the effect of malaria in lessening or destroying the productive capacity of the individual is obviously of the utmost importance, and upon the population of a malarious region is enormous, even under modern conditions and in the United States. It has been suggested that the depopulation of the once thickly settled Roman Campagna was due to the sudden introduction of malaria by the mercenaries of Scylla and Marius. Celli, in 1900, states that owing to malaria about 5,000,000 acres of land in Italy remain—not uncultivated, but certainly very imperfectly cultivated. Then also, in further example, in quite recent years malaria entered and devastated the islands of Mauritius and Réunion, practically destroying for a time the productiveness of these rich colonies of Great Britain and France.

Creighton, in his article on malaria in the Encyclopædia Britannica, states that this disease "has been estimated to produce one-half of the entire mortality of the human race; and inasmuch as it is the most frequent cause of sickness and

death in those parts of the globe that are most densely populated, the estimate may be taken as at least rhetorically correct."*

PROSPERITY OF SOUTH RETARDED BY MALARIA

The loss to this country in the way of retardation of the development of certain regions, owing to the presence of malaria, is extremely great. Certain territory containing most fertile soil and capable of the highest agricultural productiveness is practically abandoned. With the introduction of proper drainage measures and antimosquito work of other character, millions of acres of untold capacity could be released from the scourge at a comparatively slight expenditure. These regions in the absence of malaria would have added millions upon millions to the wealth of the country. Drainage measures are now being initiated by the United States. Parties of engineers are being sent by the government to make preliminary drainage surveys in the most prominent of these potentially productive regions. The following statement concerning the effect of malaria on the progress of this work has been made to the writer by Dr. George Otis Smith, director of the United States Geological Survey:

"In one of the Southern States 11 topographic parties have been at work during the past field season. The full quota for these parties would be 55 men, but I believe that something over 100 men have been employed at different times during the season. While I have not exact figures before me, I feel warranted in the statement that at least 95 per cent of these employees have been sick, for periods ranging from a few days up to two weeks, in the hospital. Many of them have been able later to return to work, but at least 30 per cent had to leave the field permanently. By reason of this sickness the efficiency of the parties was reduced, at a very conservative estimate, by 25 per cent.

"In my recent visit in this field I found one man sick in each of the parties I saw and one man who had just returned from the hospital leaving the field for good. A similar state of things was reported from the other parties. I regard the sickness as practically all of a malarial nature, as extreme care was taken in all the camps to use nothing but boiled water except in a few instances where artesian water from great depths was available. In all the camps the tents have been screened, and in every case where the topographer has lived for any time 'on the country' there has been infection. As illustrating the value of the precautions generally taken by our camp parties, I might cite the fact that last year in West Virginia with 30 men living in camp, with typhoid fever prevalent in the neighborhood, no cases developed, while with 6 men living on the country where the same care could not be taken regarding the water supply, two cases of typhoid developed."

In estimating the weight of Doctor Smith's statement, it must be borne in mind that the men of his field parties are exceptionally intelligent and prepared to take all ordinary precautions.

Throughout the region in question malaria is practically universal. The railroads suffer, and at the stations throughout the territory it is practically impossible to keep operators steadily at work. This reduction in efficiency in the surveying parties and in the local railroad officials is moreover probably very considerably less than the reduction in the earning capacity of the entire population, which, however, is necessarily scanty.

In an excellent paper entitled "The relation of malaria to agricultural and other industries of the South," published in the *Popular Science Monthly* for April, 1903, Prof. Glenn W. Herrick, then of the College of Agriculture of Mississippi, after a consideration of the whole field, concludes that malaria is responsible for more sickness among the white population of the South than any disease to which it is now subject. The following forcible statement referring to the States of Louisiana, Mississippi, Alabama,

* See "Darwinism and Malaria," by R. G. Eccles, M. D. Medical Record, New York, January 16, 1909, pp. 85-93.

Georgia, and South Carolina is in Professor Herrick's words:

"We must now consider briefly what 635,000 or a million cases of chills and fevers in one year mean. For laboring men it means an immense loss of their time together with the doctors' fees in many instances. If members of their families other than themselves be affected, it may also mean a loss of time together with the doctors' fees. For the employer it means the loss of labor at a time perhaps when it would be of greatest value. If it does not mean the actual loss of labor to the employer it will mean a loss in the efficiency of his labor. To the farmers it may mean the loss of their crops by want of cultivation. It will always mean the non-cultivation or imperfect cultivation of thousands of acres of valuable land. It means a listless activity in the world's work that counts mightily against the wealth-producing power of the people. Finally it means from two to five million or more days of sickness, with all its attendant distress, pain of body, and mental depression to some unfortunate individuals of those five states."

OUR BEST FARMING LAND UNTOUCHED BECAUSE OF MALARIA

Referring to the Delta region in Mississippi, which lies along the Mississippi River in the western part of the State of Mississippi, extending from the mouth of the Yazoo River north nearly to the Tennessee line, Herrick says that it is the second best farming land in the world, having only one rival, and that is the valley of the Nile.

"Still," says Herrick, "this land today, or at least much of it, can be bought at ten to twenty dollars an acre. Thousands of acres in this region are still covered with the primeval forest, and the bears and deer still roaming there offer splendid opportunities for the chase, as evidenced by the late visit of our Chief Executive to those regions for the purpose of hunting. Why is not this land thickly settled? And why is it not worth from two to five hundred dollars an acre? If it produces from one to two or more bales of cotton to an acre, and it does, it ought to be worth the above-named figures. A bale of cotton to the acre can be produced for thirteen dollars, leaving a net profit of twenty to forty dollars for each bale, or forty to eighty or more dollars for each acre of land cultivated. Moreover, this land has been doing that for years, and will do it for years to come, without the addition of one dollar's worth of fertilizer. Land that will produce a net profit of forty to eighty dollars an acre is a splendid investment at one, two, or even three hundred dollars an acre. Yet this land does not sell in the market for anything like so much, because the demand is not sufficient, for white people positively object to living in the Delta on account of malarial chills and fevers.

"A man said to me not long ago that he would go to the Delta that day if he were sure that his own life or the lives of the members of his family would not be shortened thereby. There are thousands exactly like him, and the only reason that these thousands do not go there to buy lands and make homes is on account of chills and fevers. But there is a time coming, and that not far distant, when malaria in the Delta will not menace the would-be inhabitants. When that time comes it will be the richest and most populous region in the United States."

RAVAGES OF MALARIA EASILY PREVENTABLE

Malaria is a preventable disease. It is possible for the human species to live and to thrive and to produce in malarious regions, but at a very considerable inconvenience and expense. The Italian investigators, and especially Celli and his staff, have shown that by screening the huts of the peasants on the Roman Campagna and by furnishing field laborers with veils and gloves when exposed to the night air, it is possible even in that famous hotbed of malaria to conduct farming operations with a minimum of trouble from the disease. Moreover, Koch and his assistants in German East Africa have shown that by stamping out

the disease among human beings by the free use of medicine, a point can be gained where there is small opportunity for the malarial mosquitoes to become infected. Moreover, the work of the parties sent out by the Liverpool School of Tropical Medicine and other English organizations to the west coast of Africa has shown that by the treatment of malarial-mosquito breeding pools the pernicious coast fever may be greatly reduced. Again, the work of Englishmen in the Federated Malay States has shown that large areas may be practically freed from malaria.

The most thorough and the most satisfactory of all measures consists in abolishing the breeding places of the malarial mosquitoes. In regions like the Delta of the Mississippi this involves extensive and systematic drainage, but in very many localities where the breeding places of the Anopheles mosquitoes can be easily eradicated, where they are readily located and are so circumscribed as to admit of easy treatment, it is possible to rid the section of malaria at a comparatively slight expense.

With a general popular appreciation of the industrial losses caused primarily by the malarial mosquito and secondarily by the forms which do not carry malaria, as indicated in the opening paragraphs, it is inconceivable that the comparatively inexpensive measures necessary should not be undertaken by the general government, by the state governments, and by the boards of health of communities, just as it is inconceivable that the individual should suffer from malaria and from the attacks of other mosquitoes when he has individual preventives and remedies at hand. Large-scale drainage measures by the general government involving large sections of valuable territory have been planned and are practically under way; certain states, notably New Jersey and New York, are beginning to work; communities all over the country through boards of health are also beginning to take notice, while popular education regarding the danger from mosquitoes and in regard to remedial measures is rapidly spreading. But all of this interest should be intensified, and the importance of the work should be displayed in the most emphatic manner, and relief from malaria and other mosquito conditions should be brought about as speedily as possible.

A few excellent examples of anti-malarial work may be instanced.

The latest reports on the measures taken to abolish malaria from Klang and Port Swettenham in Selangor, Federated Malay States, indicate the most admirable results. These measures were undertaken first in 1901 and 1902, and have been reported upon from time to time in the *Journal of Tropical Medicine*.

It seems as though malaria has been permanently stamped out at Klang and Port Swettenham, and this experience in the Malay States should be of value to those responsible for the health of communities similarly situated in many other parts of the world.

MALARIA HAS BEEN STAMPED OUT IN ISMAILIA AND HAVANA

Another striking example of excellent work of this kind is found in the recently published report on the suppression of malaria in Ismailia, issued under the auspices of the Compagnie Universelle du Canal Maritime de Suez. Ismailia is now a town of 8,000 inhabitants. It was founded by De Lesseps in April, 1862, on the borders of Lake Timsah, which the Suez Canal crosses at mid-distance between the Red Sea and the Mediterranean. Malarial fever made its appearance in very severe form in September, 1877, although the city had up to that time been very healthy, and increased so that since 1886 almost all of the inhabitants have suffered from the fever. In 1901 an attempt to control the disease was made on the mosquito basis, and this attempt rapidly and completely succeeded, and after two years of work all traces of malaria disappeared from the city. The work was directed not only against Anopheles mosquitoes, but against other culicids, and comprised the drainage of a large swamp and the other usual measures. The initial expense amounted to

50,000 francs ($9,650), and the annual expenses since have amounted to about 18,300 francs ($3,532).

The results may be summarized about as follows: Since the beginning of 1903 the ordinary mosquitoes have disappeared from Ismailia. Since the autumn of 1903 not a single larva of Anopheles has been found in the protected zone, which extends to the west for a distance of 1,000 meters from the first houses in the Arabian quarter and to the east for a distance of 1,800 meters from the first houses in the European quarter. After 1902 malarial fever obviously began to decrease, and since 1903 not a single new case of malaria has been found in Ismailia.

A very efficient piece of antimalarial work was accomplished in Havana during the American occupation of 1901 to 1902, incidental in a way to the work against yellow fever. An Anopheles brigade of workmen was organized under the sanitary officer, Doctor Gorgas, for work along the small streams, irrigated gardens, and similar places in the suburbs, and numbered from 50 to 300 men. No extensive drainage, such as would require engineering skill, was attempted, and the natural streams and gutters were simply cleared of obstructions and grass, while superficial ditches were made through the irrigated meadows.

Among the suburban truck gardens Anopheles bred everywhere, in the little puddles of water, cow tracks, horse tracks, and similar depressions in grassy ground. Little or no oil was used by the Anopheles brigade, since it was found in practice a simple matter to drain these places. At the end of the year it was very difficult to find water containing mosquito larvæ anywhere in the suburbs, and the effect upon malarial statistics was striking.

In 1900, the year before the beginning of the mosquito work, there were 325 deaths from malaria; in 1901, the first year of the mosquito work, 171 deaths; in 1902, the second year of mosquito work, 77 deaths. Since 1902 there has been a gradual though slower decrease, as follows: 1903, 51; 1904, 44; 1905, 32; 1906, 26; 1907, 23. These results, although less striking than those from Ismailia, involved a smaller expense in money and show surely an annual saving of 300 lives, and undoubtedly a corresponding decrease in the number of malarial cases, which may be estimated upon our earlier basis at something less than 40,000.

THE YELLOW FEVER MOSQUITO UNDER CONTROL

Since the discovery by the American army surgeons that yellow fever is carried by a mosquito, the *Stegomyia calopus,* the disease has been driven out of United States territory.

In what is termed the New Orleans epidemic of 1905 a striking illustration of the value of this recently acquired mosquito-transmission knowledge is seen. The presence of yellow fever in the city was first recognized about the 1st of July, but it was the 12th of August before the Public Health and Marine-Hospital Service was put in complete control of the situation. By that time the increase in new cases and deaths rendered it practically certain that the disease was as widespread as during the terrible epidemic of 1878. There had been up to that date 142 deaths from a total of 913 cases, as against 152 deaths from a total of 519 cases in 1878. The Public Health and Marine-Hospital Service, under Doctor White, took hold of the situation with energy, basing its measures almost entirely upon a warfare against *Stegomyia calopus.* The disease began almost immediately to abate, and the result at the close of the season indicated 460 deaths, as against 4,046 in 1878, a virtual saving of over 3,500 lives.

WORK ON THE ISTHMUS OF PANAMA

The United States Government has very properly used the services of Colonel Gorgas, who was in charge of the eminently successful work at Havana, by appointing him chief sanitary officer of the Canal Zone during the digging of the

canal. In 1904 active work was begun, and Colonel Gorgas was fortunate in having the services of Mr Le Prince, who had been chief of his mosquito brigades in Havana, and therefore was perfectly familiar with antimosquito methods. In Panama, as in Havana, the population had depended principally upon rain water for domestic purposes, so that every house had cisterns, water barrels, and such receptacles for catching and storing rain water. The city was divided up into small districts with an inspector in charge of each district. This inspector was required to cover his territory at least twice a week and to make a report upon each building with regard to its condition as to breeding places of mosquitoes. All the cisterns, water barrels, and other water receptacles in Panama were covered as in Havana, and in the water barrels spigots were inserted so that the covers would not have to be taken off.

Upon first inspection, in March, 4,000 breeding places were reported. At the end of October less than 400 containing larvæ were recorded. This gives one a fair idea of the consequent rapid decrease in the number of mosquitoes in the city. These operations were directed primarily against the yellow-fever mosquito, and incidentally against the other common species that inhabit rain-water barrels. Against the Anopheles in the suburbs the same kind of work was done as was done in Havana, with exceptionally good results.

The same operations were carried on in the villages between Panama and Colon. There are some twenty of these villages, running from 500 to 3,000 inhabitants each. Not a single instance of failure has occurred in the disinfection of these small towns, and the result of the whole work has been the apparent elimination of yellow fever and the very great reduction of malarial fever.

The remarkable character of these results can only be judged accurately by comparative methods. It is well known that during the French occupation there was an enormous mortality among the European employees, and this was a vital factor in the failure of the work. Exact losses cannot be estimated, since the work was done under 17 different contractors. These contractors were charged $1 a day for every sick man to be taken care of in the hospital of the company. Therefore it often happened that when a man became sick his employer discharged him, so that he would not have to bear the expense of hospital charges. There was no police patrol of the territory and many of these men died along the line.

Colonel Gorgas has stated that the English consul, who was at the Isthmus during the period of the French occupation, is inclined to think that more deaths of employees occurred out of the hospital than in it. A great many were found to have died along the roadside while endeavoring to find their way to the city of Panama. The old superintendent of the French hospital states that one day 3 of the medical staff died from yellow fever, and in the same month 9 of the medical staff. Thirty-six Roman Catholic sisters were brought over as nurses, and 24 died of yellow fever. On one vessel 18 young French engineers came over, and in a month after their arrival all but one died.

Now that the relation of the mosquito to yellow fever is well understood, it was found during the first two years under Doctor Gorgas that, although there were constantly one or more yellow fever cases in the hospital, and although the nurses and physicians were all non-immunes, not a single case of yellow fever was contracted in that way. The nurses never seemed to consider that they were running any risk in attending yellow-fever cases night and day in screened wards, and the wives and families of officers connected with the hospital lived about the grounds, knowing that yellow fever was constantly being brought into the grounds and treated in near-by buildings. Americans, sick from any cause, had no fear when being treated in beds immediately adjoining those of yellow fever patients.

Colonel Gorgas and Doctor Carter lived in the old ward used by the French

for their officers, and Colonel Gorgas thinks it safe to say that more men had died from yellow fever in that building under the French regime than in any other building of the same capacity at present standing. He and Doctor Carter had their wives and children with them, which would formerly have been considered the height of recklessness, but they looked upon themselves, under the now recognized precautions, as being as safe, almost, as they would have been in Philadelphia or Boston.

No figures of the actual cost of the antimosquito work, either in Havana or in the Panama Canal Zone, are accessible to the writer, but it is safe to say that it was not exorbitant, and that it was not beyond the means of any well-to-do community in tropical regions.

THE TYPHOID FLY, COMMONLY KNOWN AS THE HOUSE FLY

The name "typhoid fly" is here proposed as a substitute for the name "house fly," now in general use. People have altogether too long considered the house fly as a harmless creature, or, at the most, simply a nuisance. While scientific researches have shown that it is a most dangerous creature from the standpoint of disease, and while popular opinion is rapidly being educated to the same point, the retention of the name house fly is considered inadvisable, as perpetuating in some degree the old ideas. Strictly speaking, the term "typhoid fly" is open to some objection, as conveying the erroneous idea that this fly is solely responsible for the spread of typhoid; but considering that the creature is dangerous from every point of view, and that it is an important element in the spread of typhoid, it seems advisable to give it a name which is almost wholly justified and which conveys in itself the idea of serious disease. Another repulsive name that might be given to it is "manure fly," but recent researches have shown that it is not confined to manure as a breeding place, although perhaps the great majority of these flies are born in horse manure. For the end in view, "typhoid fly" is considered the best name.

In a paper entitled "A Contribution to the Study of the Insect Fauna of Human Excrement (with special reference to the spread of typhoid fever by flies)," published in the Proceedings of the Washington Academy of Sciences, Volume II, pages 541-604, December 28, 1900, the writer showed that 98.8 per cent of the whole number of insects captured in houses throughout the whole country were *Musca domestica*, the typhoid or house fly. He showed further that this fly, while breeding most numerously in horse stables, is also attracted to human excrement and will breed in this substance. It was shown that in towns where the box privy was still in existence the house fly is attracted to the excrement, and, further, that it is so attracted in the filthy regions of a city where sanitary supervision is lax and where in low alleys and corners and in vacant lots excrement is deposited by dirty people. He stated that he had seen excrement which had been deposited overnight in an alleyway in South Washington swarming with flies under the bright sunlight of a June morning (temperature 92° F.), and that within 30 feet of these deposits were the open windows and doors of the kitchens of two houses kept by poor people, these two houses being only elements in a long row. The following paragraph is quoted from the paper just cited:

"Now, when we consider the prevalence of typhoid fever and that virulent typhoid bacilli may occur in the excrement of an individual for some time before the disease is recognized in him, and that the same virulent germs may be found in the excrement for a long time after the apparent recovery of a patient, the wonder is not that typhoid is so prevalent but that it does not prevail to a much greater extent. Box privies should be abolished in every community. The depositing of excrement in the open within town or city limits should be considered a punishable misdemeanor in communities which have not already such regulations, and it should be enforced more rigorously in towns in which it is already a rule. Such offenses are generally committed after dark, and it is often

difficult or even impossible to trace the offender; therefore the regulation should be carried even further and require the first responsible person who notices the deposit to immediately inform the police, so that it may be removed or covered up. Dead animals are so reported; but human excrement is much more dangerous. Boards of health in all communities should look after the proper treatment or disposal of horse manure, primarily in order to reduce the number of house flies to a minimum, and all regulations regarding the disposal of garbage and foul matter should be made more stringent and should be more stringently enforced."

In the opening sentence of the paragraph just quoted attention was called to the activity of bacilli in excreta passed by individuals after apparent recovery from typhoid. Since the paper in question was published, more especial attention has been drawn by medical men to this point, and it has been shown that individuals who are chronic spreaders of the typhoid germs are much more abundant than was formerly supposed.

Dr. George A. Soper recently discovered a striking case of this kind in the person of a cook employed successively by several families in the vicinity of New York City, with the result that several cases of typhoid occurred in each of these families. In a paper by Doctor Davids and Professor Walker, read before the Royal Sanitary Institute of London during the present season, the history was given of four personal carriers of typhoid who had communicated the disease to a number of people. These four carriers were detected in one city within a few months, and from this fact it can be argued with justice that such cases are comparatively numerous. This being true, the presence of unguarded miscellaneous human excreta deposited in city suburbs, in vacant lots, and in low alleyways intensifies to a very marked degree the danger that the food will become contaminated with typhoid bacilli by means of the typhoid or house fly. It is known, too, that the urine of persons who have suffered from typhoid fever often contains active typhoid bacilli for several weeks after the patients have recovered; consequently this also is a source of danger.

THE HOUSE FLY ALSO SPREADS INTESTINAL DISEASES, CHILDREN'S COMPLAINTS, AND CONSUMPTION

It is not alone as a carrier of typhoid that this fly is to be feared. In the same way it may carry nearly all the intestinal diseases. It is a prime agent in the spreading of summer dysentery, and in this way is unquestionably responsible for the death of many children in summer.

In a report by Daniel D. Jackson to the committee on pollution, of the Merchants' Association in New York, published in December, 1907, the results of numerous observations upon the relation of flies to intestinal diseases are published, and the relation of deaths from intestinal diseases in New York City to the activity and prevalence of the common house fly is shown not only by repeated observations but also by an interesting plotting of the curve of abundance of flies in comparison with the plotted curve of abundance of deaths from intestinal diseases, indicating that the greatest number of flies occurred in the weeks ending July 27 and August 3; also, that the deaths from intestinal diseases rose above the normal at the same time at which flies became prevalent, culminated at the same high point, and fell off with slight lag at the time of the gradual falling off of the prevalence of the insects.

The typhoid fly also possesses importance as a disseminator of the bacilli of tuberculosis. In a paper by Dr. Frederick T. Lord, of Boston, reprinted from the *Boston Medical and Surgical Journal* for December 15, 1904, pages 651-654, the following conclusions are reached:

"1. Flies may ingest tubercular sputum and excrete tubercle bacilli, the virulence of which may last for at least fifteen days.

"2. The danger of human infection from tubercular flyspecks is by the ingestion of the specks on food. Spontaneous

liberation of tubercle bacilli from fly-specks is unlikely. If mechanically disturbed, infection of the surrounding air may occur.

"As a corollary to these conclusions, it is suggested that—

"3. Tubercular material (sputum, pus from discharging sinuses, fecal matter from patients with intestinal tuberculosis, etc.) should be carefully protected from flies, lest they act as disseminators of the tubercle bacilli.

"4. During the fly season greater attention should be paid to the screening of rooms and hospital wards containing patients with tuberculosis and laboratories where tubercular material is examined.

"5. As these precautions would not eliminate fly infection by patients at large, foodstuffs should be protected from flies which may already have ingested tubercular material."

The danger of the typhoid or house fly in the carriage of disease has thus been abundantly demonstrated, and yet it is allowed to breed unrestricted all over the United States; it is allowed to enter freely the houses of the great majority of our people; it is allowed to spread bacteria freely over our food supplies in the markets and in the kitchens and dining-rooms of private houses, and, to use the happy phraseology of Dr. Theobald Smith, "when we go into public restaurants in midsummer we are compelled to fight for our food with the myriads of house flies which we find there alert, persistent, and invincible."

Even if the typhoid or house fly were a creature difficult to destroy, the general failure on the part of communities to make any efforts whatever to reduce its numbers could properly be termed criminal neglect; but since it is comparatively an easy matter to do away with the plague of flies, this neglect becomes an evidence of ignorance or of a carelessness in regard to disease-producing filth which to the informed mind constitutes a serious blot on civilized methods of life.

HOW TO KEEP THE FLIES AWAY

If we allow the accumulation of filth we will have house flies, and if we do not allow it to accumulate we will have no house flies. With the careful collection of garbage in cans and the removal of the contents at more frequent intervals than 10 days, and with the proper regulation of abattoirs, and more particularly with the proper regulation of stables in which horses are kept, the typhoid fly will become a rare species. It will not be necessary to treat horse manure with chloride of lime or with kerosene or with a solution of Paris green or arsenate of lead, if stablemen are required to place the manure daily in a properly covered receptacle and if it is carried away once a week.

The orders of the Health Department of the District of Columbia, published May 3, 1906, if carried out will be very effective. These orders provide for the keeping of manure in watertight bins or pits or barrels, protected from flies.

In addition to this excellent ordinance, others have been issued from the Health Department of the District of Columbia which provide against the contamination of exposed food by flies and by dust. The ordinances are excellently worded so as to cover all possible cases. They provide for the registration of all stores, markets, cafés, lunch rooms, or of any other place where food or beverage is manufactured or prepared for sale, stored for sale, offered for sale, or sold, in order to facilitate inspection, and still more recent ordinances provide for the registration of stables. An excellent campaign was begun during the summer of 1908 against insanitary lunch rooms and restaurants. A number of cases were prosecuted, but conviction was found to be difficult.

For one reason or another, the chief reason being the lack of a sufficient force of inspectors under the control of the health officers, the ordinance in regard to stables has not been carried out with that perfection which the situation demands.

Were simple inspection of stables all that is needed, a force of four inspectors, specially detailed for this work, could cover the District of Columbia, examining every stable, after they were once located and mapped, once a week. The

average salary of an inspector is $1,147, so that the total expense for the first year would be something like $4,500. But the inspectors' service is complicated by the matter of prosecution. Much of the time of inspectors would be taken in the prosecution of the owners of neglected premises. Moreover, the health officer has found during the summer of 1908, in his prosecution of the owners or managers of insanitary restaurants, that his inspectors were practically sworn out of court by the multiplicity of opposing evidence. This means that it will be necessary in such cases to send two inspectors together in all cases, so that the testimony of one may be supported by the testimony of the other. This, perhaps, would double the number of necessary inspectors, making the expense of the service something over $9,000.

It is reasonably safe to state, however, that with such an expense for competent service, or perhaps with a slightly added expense, the typhoid fly could be largely eliminated as an element in the transfer of disease in the District of Columbia, and the difficulty which the authorities have had in locating the cause of a very considerable proportion of the cases of typhoid in the District for the past two or three years indicates plainly to the mind of the writer that the typhoid fly is a much more important element than has been supposed. It is a comforting although comparatively insignificant fact and a matter of common observation that in certain sections of the city the typhoid fly has been much less numerous during the past summer than in previous years. The writer is inclined to attribute this to the gradual disappearance of horse stables in such sections, brought about by the rapidly increasing use of motor vehicles.

PUBLIC INDIFFERENCE TO THE TYPHOID FLY IS CRIMINAL

We have thus shown that the typhoid or house fly may carry typhoid fever, Asiatic cholera, dysentery, cholera morbus, and other intestinal diseases; it may carry the bacilli of tuberculosis and certain eye diseases; it is everywhere present, and it is disposed of with comparative ease. It is the duty of every individual to guard so far as possible against the occurrence of flies upon his premises. It is the duty of every community, through its board of health, to spend money in the warfare against this enemy of mankind. This duty is as pronounced as though the community were attacked by bands of ravenous wolves.

As a matter of fact, large sums of money are spent annually in the protection of property in the United States. Large sums of money are spent also in health matters; but the expenditure for protection from flies is very small and is misdirected. There is much justification for the following criticism published editorially in the Journal of the American Medical Association for August 22, 1908, under the caption, "National Farm Commission and Rural Sanitation:"

"The President calls attention to the fact that all efforts to aid the farmers have hitherto been directed to improving their material welfare, while the man himself and his family have been neglected. Nowhere is this more marked than in the attitude of the general government in matters relating to sanitation. It is a trite saying that whereas the government, through the Department of Agriculture, aids the farmer generously in caring for the health of his hogs, sheep, etc., it does nothing for his own health. The government issues notices to the farmer of the injury done to his crops by the cotton-boll weevil and the potato bugs and how to combat them, but the injury the mosquito does in spreading malaria to the people who pick the cotton and hoe the potatoes is not impressed on him. The fact that horseflies may carry anthrax to his cattle is dealt with at considerable length, but the diseases which the house fly spreads to the milk and to the farmer's family attract practically no attention. How to build a hogpen or a sanitary barn is the subject of a number of government publications, but how to build a sanitary privy which will prevent the spread of typhoid, hook worm,

and many other diseases is regarded as of strictly local interest."

But this criticism is not entirely justified, since there was published by the Bureau of Entomology of the United States Department of Agriculture, in 1900, a Farmers' Bulletin, entitled "How Insects Affect Health in Rural Districts,"* in which all of these points mentioned by the editor of the Journal of the American Medical Association have been touched upon, and at the date of present writing 192,000 copies of this bulletin have been distributed among the people. Moreover, a number of years ago a circular† was published on the subject of the house fly, calling attention to its dangers and giving instructions such as are covered in a general way in this article, and some 18,000 copies of this circular have also been distributed. This is an indication that the general government is by no means blind to the people's needs in such matters as we have under consideration, but further work should be done. That the English government is awaking to the same need is shown by the fact that, in the parliamentary vote of the present year in aid of scientific investigations concerning disease, one of the projects supported by the general government was the investigation of Doctors Copeman and Nuttall on flies as carriers of disease.

A leading editorial in an afternoon paper of the city of Washington, of October 20, 1908, bears the heading, "Typhoid a National Scourge," arguing that it is today as great a scourge as tuberculosis. The editorial writer might equally well have used the heading "Typhoid a National Reproach," or perhaps even "Typhoid a National Crime," since it is an absolutely preventable disease. And as for the typhoid fly, that a creature born in indescribable filth and absolutely swarming with disease germs should practically be invited to multiply unchecked, even in great centers of population, is surely nothing less than criminal.

* Farmers' Bulletin No. 155.

† Circular No. 35, Bureau of Entomology, 1891, afterwards reissued in revised form as Circular No. 71.

ENDEMIC DISEASE AS AFFECTING THE PROGRESS OF NATIONS

In referring to the spread of malaria in Greece, the relation of this disease to the rise and fall of national power has been touched upon in an earlier paragraph. The subject is one of the widest importance and deserves a more extended consideration.

The following paragraphs are quoted from Ronald Ross's address on Malaria in Greece, delivered before the Oxford Medical Society, November 29, 1906:

"Now, what must be the effect of this ubiquitous and everlasting incubus of disease on the people of modern Greece? Remember that the malady is essentially one of infancy among the native population. Infecting the child one or two years after birth, it persecutes him until puberty with a long succession of febrile attacks, accompanied by much splenomegaly and anæmia. Imagine the effect it would produce upon our own children here in Britain. It is true that our children suffer from many complaints—scarlatina, measles, whooping cough—but these are of brief duration and transient. But now add to these, in imagination, a malady which lasts for years, and may sometimes attack every child in a village. What would be the effect upon our population—especially our rural population—upon their numbers and upon the health and vigor of the survivors? It must be enormous in Greece.

"People often seem to think that such a plague strengthens a race by killing off the weaker individuals; but this view rests upon the unproven assumption that it is really the weaker children which cannot survive. On the contrary, experience seems to show that it is the stronger blood which suffers most—the fair, northern blood which nature attempts constantly to pour into the southern lands. If this be true, the effect of malaria will be constantly to resist the invigorating influx which nature has provided; and there are many facts in the

history of India, Italy, and Africa which could be brought forward in support of this hypothesis.

"We now come face to face with that profoundly interesting subject, the political, economical, and historical significance of this great disease. We know that malaria must have existed in Greece ever since the time of Hippocrates, about 400 B. C. What effect has it had on the life of the country? In prehistoric times Greece was certainly peopled by successive waves of Aryan invaders from the north—probably a fair-haired people—who made it what it became, who conquered Persia and Egypt, and who created the sciences, arts, and philosophies which we are only developing further today. That race reached its climax of development at the time of Pericles. Those great and beautiful valleys were thickly peopled by a civilization which in some ways has not been excelled. Everywhere there were cities, temples, oracles, arts, philosophies, and a population vigorous and well trained in arms. Lake Kopais, now almost deserted, was surrounded by towns whose massive works remain to this day.

"Suddenly, however, a blight fell over all. Was it due to internecine conflict or to foreign conquest? Scarcely; for history shows that war burns and ravages, but does no annihilate. Thebes was thrice destroyed, but thrice rebuilt. Or was it due to some cause, entering furtively and gradually sapping away the energies of the race by attacking the rural population, by slaying the new-born infant, by seizing the rising generation, and especially by killing out the fair-haired descendant of the original settlers, leaving behind chiefly the more immunised and darker children of their captives, won by the sword from Asia and Africa? * * *

"I cannot imagine Lake Kopais, in its present highly malarious condition, to have been thickly peopled by a vigorous race; nor, on looking at those wonderful figured tombstones at Athens, can I imagine that the healthy and powerful people represented upon them could have ever passed through the anæmic and splenomegalous infancy (to coin a word) caused by widespread malaria. Well, I venture only to suggest the hypothesis, and must leave it to scholars for confirmation or rejection. Of one thing I am confident, that causes such as malaria, dysentery, and intestinal entozoa must have modified history to a much greater extent than we conceive. Our historians and economists do not seem even to have considered the matter. It is true that they speak of epidemic diseases, but the endemic diseases are really those of the greatest importance. * * *

"The whole life of Greece must suffer from this weight, which crushes its rural energies. Where the children suffer so much, how can the country create that fresh blood which keeps a nation young? But for a hamlet here and there, those famous valleys are deserted. I saw from a spur of Helikon the sun setting upon Parnassus, Apollo sinking, as he was wont to do, towards his own fane at Delphi and pouring a flood of light over the great Kopaik Plain. But it seemed that he was the only inhabitant of it. There was nothing there. 'Who,' said a rich Greek to me, 'would think of going to live in such a place as that?' I doubt much whether it is the Turk who has done all this. I think it is very largely the malaria."

In considering carefully this suggestive argument of Major Ross, does it not appear to indicate the tremendous influence that the prevalence of endemic disease must exert upon the progress of modern nations, and does it not bring the thought that those nations that are most advanced in sanitary science and preventive medicine will, other things being equal, assume the lead in the world's work?

Who can estimate the influence of the sanitary laws of the Hebrew Scriptures upon the extraordinary persistence of that race through centuries of European oppression—centuries full of plague years and of terrible mortality from preventable disease?

And what more striking example can be advanced of the effect of an en-

lightened and scientifically careful attention to the most recent advances of preventive medicine upon the progress of nations than the mortality statistics of the Japanese armies in the recent Russo-Japanese war as compared with the corresponding statistics for the British army during the Boer war immediately preceding, or for the American army during the Spanish war at a somewhat earlier date?

The consideration of these elements of national progress has been neglected by historians, but they are nevertheless of deep-reaching importance and must attract immediate attention in this age of advanced civilization. The world has entered the historical age when national greatness and national decay will be based on physical rather than moral conditions, and it is vitally incumbent upon nations to use every possible effort and every possible means to check physical deterioration.

LIFE IN THE GREAT DESERT OF CENTRAL ASIA

By Ellsworth Huntington, of Yale University

IT seems a strange anomaly that the most remarkable ruins of ancient civilization are often closely associated with deserts. In North America the great Aztec and Zuni ruins lie in the arid regions of the Southwest and of Mexico; in South America the wonderful remnants of the great Inca cities are located in the dry regions of Bolivia, Peru, and northern Argentina. In Africa, likewise, the Rhodesian ruins, the most remarkable in the southern part of the continent, lie near the Kalahari Desert, while in the north the remains of some of the most famous ancient empires border the Sahara from Morocco to Egypt. Asia, too, is no exception, for Arabia, Syria, Mesopotamia, Persia, northwestern India, and western China are all distinguished for their ruins and their deserts.

One of the most interesting examples of the combination of the ruins of a mighty past with conditions of great aridity today is found in the Russian province of Transcaspia, east of the Caspian Sea. Thither in 1903 it was the author's privilege to go as a member of an expedition sent out by the Carnegie Institution of Washington for archeological and geographical research under the leadership of Mr Raphael Pumpelly. During the course of two seasons' work we not only studied the ruins, but gained a fairly intimate acquaintance with the Turkoman inhabitants of the country—its rulers before the Russian conquest, less than thirty years ago. In our study of both the past and the present nothing was more impressive than the inexorable influence which the desert has exercised upon living creatures of every sort.

We entered Transcaspia from oily Baku, crossing the Caspian Sea to Krasnovodsk, and thence going by rail to Askhabad, the capital of the province, and to Merv, the most famous of the ancient cities. From the high, narrow windows of the deliberate train the traveler who elects to sit on the edge of the car seat, and sacrifice comfort to scientific curiosity, may see all of the few simple features which make up the physiography of Transcaspia. After the train has left the opalescent waters of the Bay of Krasnovodsk and has run through the desert for some hours, it comes at length to the Yuzboi, the broad abandoned channel of an ancient river which once flowed from the Sea of Aral or the marsh of Sarikamish to the Caspian Sea in the days when the climate of the country was

more propitious than now, and ancient empires flourished in what is now the desert.

Soon the train begins to run parallel to the mountains of northern Persia, which raise their barren brown flanks through the quivering air 20 or 30 miles away to the south. Between their base and the railway lies a sloping plain of gravelly soil washed down from the mountains by spring floods and fertile only where a rare brook is led abroad in canals to water the earth, or where tunnels, marked by long lines of wells with heaps of debris at their mouths, have been dug for miles into the gravel to rob it of its scanty store of water.

THE OASES OF THE DESERT

On the other side of the railway a great plain of desert sand stretches far away toward the north in the direction of the bleak plateau of Ust-urt and the famed city of "lone Khiva in the waste." Between the desert and the mountains lie the oases of Transcaspia, dusty green beads, large and small, strung on a two-stranded string of shining steel rails. Pleasant, cool, fruitful places they seem to the sun-blackened nomad of the desert, although to the luxurious traveler on the railroad the dusty streets and adobe houses present little that is lovely. Occasionally the house of a Russian official, low, white-washed, and red-tiled, presents a hint of picturesqueness as it stands embowered in fruit trees laden with mulberries, apricots, plums, peaches, quinces, and pomegranates; but the ground below the trees is dry and grassless, and the breath of the desert blights every spot where standing or running water is not found.

On the outskirts of almost every oasis stand the symbols of two types of civilization whose day is past. On the one side a cluster of round felt tents, a flock of fat-tailed brown and white sheep, some kneeling, grunting camels, and a group of Turkoman nomads in long-striped quilted gowns of native red silk and huge caps of sheepskin represent the recent days when the Turkomans cheerfully plundered their neighbors, the mild Persians, or any one else whom sad mischance betrayed into their hands. On the other side huge earthen mounds or lines of fallen walls of sun-dried brick indicate that centuries ago the barren wastes which now lie desolate were the home of a prosperous and numerous race of tillers of the soil.

During our stay in Transcaspia we visited the mountains to the south of the railroad, made excursions into the desert to the north, and lived for months among the oases and deserts between the other two regions. Nowhere during all our stay did we feel that we had left the desert behind. On our way to the mountains at the end of May the growth of short, sweet grass which covers the country in early spring had already died and shriveled. The gently sloping plain of gravel at the base of the foot-hills was brown and barren except for dry weeds and little bushes.

Among the mountains themselves the bottoms of the deep canyons were either green with grass among which blue irises were blooming, or else were filled with a jungle of low trees and fragrant rose bushes. Nevertheless a glance upward disclosed bare walls of rock and talus so dry that not a speck of green could be detected. At the heads of the canyons green upland valleys and plateaus appeared, tenanted by pastoral Kurds who leave their stone houses in summer and dwell in tents.

The immediate scenery at these high altitudes of 6,000 or 8,000 feet did not suggest the desert, but from the snow-flecked peaks 9,000 or 10,000 feet above the sea a yellow band on the horizon and a dusty haze in the distant air could be seen proclaiming the great waste of sand a day's journey to the north, and we knew that in a month or two even the mountains would be parched and brown.

THE KURDS AND THE TURKOMANS

The Kurds, who inhabit the highlands south of Transcaspia are in themselves a forcible reminder of the desert. Three centuries ago in the days of Abbas Shah, the last great king of Persia, the Tartars,

A SAMPLE OF THE MOUNTAINOUS SOUTHERN BORDER OF TRANSCASPIA, SHOWING THE SCANTY VEGETATION AND THE STERILE NATURE OF THE MOUNTAINS

TURKOMAN TENTS ON THE EDGE OF THE TRANSCASPIAN DESERT

who preceded their Turkoman cousins in Transcaspia, seem to have found life unusually hard among the waterless, grassless pastures of sand and gravel. At any rate, they raided the gentle, courteous Persians with unendurable ferocity. On the western borders of his realm lived another race of plunderers, the Kurds, and it occurred to Abbas Shah that the one race might be pitted against the other. Accordingly he transported some 100,000 Kurds to the mountains of Khorasan

SCENES ALONG THE TRANSCASPIAN RAILROAD IN THE MIDST OF THE DESERT

Great fields of sand such as this often lie within only a few miles of scenes of occasional floods like that shown in the second picture. In the sandy places much difficulty is experienced in keeping the sand from drifting over the tracks and preventing the running of trains. During the floods of May the railroad often suffers severely, sections many miles in length being sometimes washed away.

south of Transcaspia. For a time they put a stop to the raids of the warriors of the desert, but not permanently, perhaps because among the mountains life was easier than in the desert, and there was consequently less temptation to commit robbery when a dry season or swarms of locusts ruined the scanty crops and pasturage.

The Tartars and their Turkoman successors did not often rob the Kurds, for that was dangerous, but until the coming

of the Russians less than a generation ago, their dearest delight was long, hard rides of 80 or 100 miles in a single day on slave-taking raids among the timid Persians. No pity was shown to the poor captives; with chained hands and blistered feet, stumbling and faint, they were driven hundreds of miles at the point of the spear to be finally sold in the slave markets of the rich oases of Bokhara and Khiva.

Far in the interior of eastern Persia, beyond the mountain home of the transported Kurds, the traveler is often surprised by being addressed by native Persians in Turki, the language of the Turkomans, as the writer discovered during a journey which succeeded the one here described. Time and again they tell the same tale: "Years ago in my boyhood I was working in the fields toward sunset, when some one in the watch tower shouted, 'The Turkomans, the Turkomans.' We dropped our work and ran for shelter, but the Turkomans caught us. Six men they killed that day, and fifteen of us they drove to Khiva. There we lived and worked for hard masters twelve years until the Russians came and freed us. God bless the Russians. The Turkomans are fiends."

In spite of their cruel raids the Turkomans are admirable people—brave, generous, and honest, faithful and industrious, and possessing that greatest of virtues, profound respect for women. At least such was the case till recently, although of late contact with Russian civilization is beginning to have the same sad effect which contact with American civilization has had upon the Indians.

A RIDE INTO THE DESERT

A week's ride out into the sand north of Merv at the end of June gave opportunity to see how friendly the Turkomans are and how terrible is their desert. At first our way led through the unkempt fringe of brown stubble and weed-bordered ditches which surrounds every oasis; then came stretches of clayey plain with just a trace of grass; and finally the sand itself, a vast undulating expanse of dunes, indescribably graceful in their smooth crescentic curves, and strangely beautiful in tint and shading during the cool sunrise hours when the long shadows bring out every slightest hollow or ripple.

As the midsummer sun rises higher the landscape flattens and assumes a garish tint of yellowish gray, inexpressibly wearisome. Strange mirages torment the vision, but never are really deceitful—perchance a group of tents beside a pool of sparkling blue water, or a string of camels pacing slowly along above the horizon in the lower portion of the sky with heads to earth and feet to the unsubstantial floor of heaven.

"By Allah!" remarked the guide on the first day of our journey, "I wish I had brought a thicker robe. I had no idea it would be so hot. The sun beats right through this thin thing, and only the grace of Allah keeps me from being burned to a cinder."

During the heat of the day we rested for two or three hours; that is, we lay down on the burning sand in the shade of a bit of cloth or of our horses—thin, patient animals—and wrote up notes, the bane of the explorer's life, or tried to sleep and forget the heat. The end of the noon siesta was always the worst part of the day. We fairly staggered when we rose to mount our horses; and the still, suffocating heat made us clutch at the saddles to keep from swaying and falling as the dispirited creatures plodded heavily on. Soon, however, a little breeze arose regularly, the horses began to step more lightly, the shadows lengthened, and the world grew interesting.

By sunset we had reached a group of tents, a well, some tamarisk bushes, and flocks of bleating sheep, with here and there a camel from whose gaunt leather sides a few handfuls of last winter's coat of hair still clung. Friendly Turkomans took our horses and gave us cool drafts of the acrid sour milk, which all men love in the desert. In the cool of the evening we sat and talked with our hosts while waiting for dinner of curdled milk, coarse wheaten bread, and the flesh of a young lamb pulled to pieces with the fingers.

RUIN OF AN OLD MOSQUE IN THE LOWER PORTION OF THE MERV OASIS WHERE CULTIVATION HAS NOW BEEN GIVEN UP

RUINS IN THE UPPER PORTION OF THE MERV OASIS WHERE CULTIVATION IS STILL CARRIED ON

In the background may be seen the mud walls of the last of the great cities of Merv

When conversation at length gave place to idle reverie we went to sleep in the open air, regretting the pleasant weariness which made it impossible to remain awake in order to watch the surpassing beauty of the flawless sky and feel the caress of the gentle breeze of the desert.

The purpose of our ride into the desert was the examination of numerous great mounds from 30 to 80 feet high and from 100 to 600 feet in diameter, which are located outside the oasis of Merv. Here in ancient days, when the water supply was greater than it now is, the chief men of the land appear to have lived, raised above the heat of the plain and protected by moats and walls, while around them dwelt the humble peasants whose mud houses have now crumbled into scarcely perceptible heaps covered with countless potsherds. Elsewhere whole villages seem to have been built upon mounds, as they are today in eastern Persia in places of especial danger.

The Turkomans were puzzled when they saw a stranger riding from ruin to ruin, writing, photographing, measuring. "Have you heard what the stranger is doing?" they said to one another, according to the report of the guide. "You know he comes from the west, so he says, from across a lake bigger than the desert. Now these old mounds were built long ago by the Giants whom our ancestors, blessed of Allah, drove far away into the western mountains. There some of the infidels still live. The Americans are infidels. It must be that the Giants are their ancestors, and this man has come here to see where his ancestors lived."

Another matter which puzzled the Turkomans was the fact that I wrote a great deal on horseback. The guide told of their speculations. "It must be," he reported them as saying, "that this is a very religious man. He knows the Koran, or his holy book, whatever it may be, by heart, and as he rides along he writes it down for pleasure."

The means of supporting life in Transcaspia are much more abundant in the oases than elsewhere, but even there they are very precarious. During April and May, 1903, the camp of the Pumpelly expedition was pitched at Anau, a small oasis near Askhabad, the Transcaspian capital. There, with the aid of about 120 Turkomans, we excavated two mounds, the remains of a village of extreme antiquity, founded in the days when the camel, sheep, and pig were still undomesticated and were hunted by the villagers who later tamed them, apparently in the very village into the ruins of which we dug.

A PLAGUE OF LOCUSTS

One day in April a spirit of unrest appeared among our Turkoman workmen, for a whisper went abroad that this was to be a year of grasshoppers. The rumor was only too true, for before many days the green grass and the fields of tender wheat nearest the mountains were full of round, dark spots no bigger than a dollar, and composed of almost microscopic living creatures.

Day by day the spots grew larger, like the spreading of a plague, at first a foot in diameter, then three feet, and soon ten. Little by little, too, the tiny swarming creatures became visible as individuals—genuine grasshoppers, minute, but appallingly voracious. Here and there a Turkoman could be seen with a spade attempting to cover the plague-spots with earth, but in general the grasshoppers were left unmolested.

The faces of the Turkomans grew graver day by day as the creatures increased in size, and the men stuck to their work of digging more faithfully than before, seeming to feel that they must earn as much as possible to support their families in the hard days to come. There was no complaint, no cursing; they seemed to look upon the myriad-mouthed horde of grasshoppers as an affliction sent by Allah, and not to be opposed by ordinary human means.

At length there came a day when the grasshoppers, now nearly half an inch in length, began to move more widely, and broad patches of sere brown stubble could be seen where they had devastated parts of the wheat fields. About the same

A KURDISH WRESTLING MATCH OUTSIDE A MOUNTAIN VILLAGE

The inhabitants are descended from the Kurds brought by Abbas Shah to oppose the Turkomans

A VILLAGE OF TURKOMANS WHO HAVE GIVEN UP THE NOMADIC LIFE IN LARGE MEASURE

The houses are built entirely of mud, even the domes containing no wood whatever

time a new and most welcome factor entered into the situation; rose starlings, northward bound on their annual migration, appeared upon the scene one morning. A pleasant light came into the faces of the Turkomans as they pointed to the great flocks of rosy-breasted, black-winged birds which circled over the plain in troops like blackbirds in America during the fall of the year. They ate voraciously; and thousands, nay, millions, of the pestiferous insects were devoured in a single day.

On the following morning the number

of starlings had increased, and the third day the swarms of birds almost darkened the sky when, in their frequent flittings, a flock passed overhead. That day the headman of the village asked us for contributions to a fund for getting rid of the grasshoppers.

"These starlings," said he, "are the children of a sacred spring among the Persian mountains two days' journey to the south of here. Wherever the water is, there the birds gather. Allah, the Merciful, has sent many birds to us, but they are not enough. We must do something to get more of them. There is just one way to do it. If we can get some of the water and bring it here, the birds will follow it. So today I am collecting money. Tomorrow, by the grace of Allah, I will send Verdi, the Mullah, our most holy man, to get the water. In his hand he must carry a good present, for the water is of no use unless it is taken from the spring and blessed by the holy sheikhs who guard it from pollution."

Three days later the headman was radiant. "See," said he, "how thick the birds are," and truly they were circling over the wheat fields in extraordinary numbers. "Last night our messenger reached the spring, and already the birds have begun to come. Today he will stay there; then it will take him two days to get back, bringing the vessel of water. Wait till the fourth day from now, the morning after he arrives, and see the multitude of birds."

On the third morning the headman looked old and weary, and had scarcely a word of greeting. The birds were gone; not a solitary starling was to be seen. In the night, silently, swiftly, as they had come, so they went, flying northward according to their wont, in response to the changing seasons. No thought of migrations came to the Turkomans. One thing alone they knew—the birds had gone, the grasshoppers remained, and the crops were doomed to utter ruin. Perhaps a little of the unripe grain could be cut for fodder, but nothing could be saved for food for themselves and their children.

Some one had blundered; perhaps some impious deed had been committed; therefore Allah had refused the further aid of his sacred birds. There was no further talk of a joyful procession to meet the Mullah far from the village and bringing the jar of sacred water home in triumph. The holy man stole into the village dejected and unnoticed, while the villagers thought only of their ruined crops and their families, which would soon be hungry.

THE MARCH OF MILLIONS

The days that followed were like a nightmare. The insects were now full grown, and on a day they all began to move. Northeastward they went toward the desert—slowly, very slowly, but steadily, hopping, hopping, hopping, rarely pausing, never turning to one side. A low rattle filled the air like the steady falling of fine sleet, and everywhere there was a faint, sickening odor. It was impossible to walk without stepping on the creatures.

On the morning when the grasshoppers began to move the writer was at work in a round native tent of felt, with the top, perhaps 30 inches in diameter, open to admit light and air. When the grasshoppers reached the tent not one of them turned aside. Straight up the wall they crawled, and straight across the top until they came to the opening. There they paused a few minutes and then jumped blindly. One after another they landed on the table, which was necessarily placed under the opening for light. Tap, tap, tap, they fell at intervals of a few seconds until it soon became impossible to work. When they righted themselves after falling to the floor, they always turned in the original direction, hopping across the floor, climbed the wall and the inside of the roof of the tent until they reached the opening at the apex, and were able to continue their interrupted journey.

Near our tents flowed a brook about three feet wide, which was used for irrigation. When the grasshoppers reached it they paused a moment, and then, urged

ERECTING A TURKOMAN TENT

The poles and lattice-work are made of the lightest possible wood, in order to be easily transported

A TURKOMAN READY FOR THE TRAIL

Before the coming of the Russians, Turkomans mounted and equipped just as is this man often rode 80 or 100 miles in a day on slave-taking raids into Persia

KURDISH WOMEN AND CHILDREN AMONG THE MOUNTAINS ON THE NORTHERN FRONTIER OF PERSIA CLOSE TO TRANSCASPIA

A GROUP OF TURKOMANS

Notice the various types of sheepskin cap and the coat of sheepskin which the right-hand man wears even in summer.

by the crowds coming up from behind, jumped into the water and struggled for the other bank. The majority reached it after being carried down a few hundred feet. On the bank they rested in swarms until their wings were dry, and then hopped steadily on.

Many of the weaker insects, however, never got across the stream alive. They were carried down to the point where the brook was distributed over the fields, and there were deposited in great heaps, which soon began to emit a most noisome odor.

OUR EXCAVATIONS CHOKED BY THE INSECTS

The coming of the grasshoppers had a disastrous effect upon our work of excavation. The insects jumped into the diggings in hordes, falling over the perpendicular edges in a steady stream. Crossing the bottom of the excavations in their usual persistent manner, they tried again and again to climb the steep walls, only to grow weary before reaching the top, and so to fall back once more. Thus they piled up to a depth of a foot or two in every excavation. At first we tried to have them shoveled out, but the accumulation of a single night could scarcely be removed in a day. As most of our work was finished, we merely shoveled earth into the pits to cover the loathsome, dying mass of insects. Once in the bottom of a deep, round well sunk in exploring the ruins, we found a large snake buried in a seething, squirming, ever-deepening mass of living death from which his writhing head alone protruded.

There was one excavation which we determined not to abandon at once. As quickly as possible, which was not till the end of the second day, we procured cheese-cloth and stretched it across the top of the excavation. The grasshoppers crossed by legions, their shadows darkening the cloth, and the sound of their hopping was like the patter of heavy rain on a roof.

The work of cleaning out grasshoppers was intensely disagreeable. Even in the upper portions of the excavation the insects swarmed everywhere, and it was continually necessary to brush the sticky creatures from hands, arms, head, and neck.

The Turkoman laborers were clad in baggy white cotton trousers of the common full Turkish type, worn without underclothes. To stand in such garments amid the grasshoppers and shovel them into buckets or bags while the creatures crawled everywhere must have been almost unendurable. Every few minutes the men stopped to remove the clinging insects from inside their clothes. Nevertheless not only did those who were at work keep on faithfully, but scores of others, seeing that the grasshoppers had consumed their sustenance for the year, pleaded piteously for an opportunity to earn something to support their wives and children.

The visitation came to an end at length, and the grasshoppers passed on into the desert. The land was left reaped—consumed, as it were, by fire. There was a strange stillness in the air, and though our tents were pitched in what had been the fruitful grain fields of an oasis, we seemed to be in the midst of the great desert.

When the locusts were gone and the Turkomans were left idle, discouraged, and moody, it was easy to see how the precarious conditions of Turkoman life have contributed to the formation of the warlike, plundering character for which the people of the desert are noted. Little groups of malcontents gathered here and there and began to talk against the Russian government. "How shall we live?" they said. "We cannot plunder our neighbors, as our fathers did, for the Great White King has his soldiers everywhere. We have no flocks, for since the Russians persuaded us to settle in the oases permanently, we have kept only a few sheep. If we and our little ones starve, it is the fault of the Russians. Give us the old free days again."

Devoid of genuine foundation as such mutterings may be, they nevertheless cannot be lightly disregarded. Probably the Turkomans are as comfortable today as in the past, and possibly more so, for the Russian rule is far from oppressive; but such a thought is remote from the minds of the Turkomans. Now, as in the past, when pitiless nature causes them to suffer, they strive to fix the blame upon man, and to retrieve their fortunes by inflicting pain upon those whom they deem their enemies. Only the conquest of the desert can free them from the constantly recurring menace of hunger.

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THE NATIONAL GEOGRAPHIC MAGAZINE

THE GLASS-BOTTOM BOAT

By Charles Frederick Holder

Author of "Big Game Fishes," "Life of Charles Darwin," Etc.

THE old tar who described his ship to a landsman as having three decks and no bottom would doubtless be surprised to see how near modern invention has copied his description, as the glass-bottom boat in its evolution has two or three decks and almost no bottom, in place of which are great panes of glass or windows, down through which the bold navigator looks and sees the wonders of the sea.

Many years ago I used a glass-bottom box on the Florida reef for collecting rare corals, and when something was seen in fifteen or twenty feet of water we dived down and brought it up. In this way I had delightful experiences and came in a few years to know the great reef about Garden Key like a book, all from these submarine excursions, soon being able to remain under water a minute, a short time compared to the Japanese or Hawaiian divers.

When I first visited the channel islands of southern California, some twenty years ago, I was impressed with the beauty of the kelp beds and the marine fauna, and had a glass-bottom box made and also planned a glass-bottom boat. From this, and doubtless the suggestions of others as well, has grown an extraordinary avocation, that of the glass-bottom boat. The capital invested in all probability is nearly $100,000 and the income is a good and increasing one, due to the fact that the attractive island of Santa Catalina is the Mecca for thousands of tourists annually, most of whom go out in the glass-bottom boats.

When you land in the beautiful Bay of Avalon, about thirty miles from San Pedro, the port of Los Angeles, you are met, not by hackmen, but by glass-bottom boatmen: "Here you are! Marine Jimmie's boat, only fifty cents." "Take the *Cleopatra*" or "Right away now for the Marine Gardens." And the ocean steamer is met in the bay by these strange craft, that look like the old-fashioned river side-wheelers. These boats are made on the island, and range from row-boats with glass bottoms to large side-wheel steamers valued at $3,000. There is a fleet of them, big and little, and they skim over the kelp beds, and have introduced an altogether new variety of entertainment and zoölogical study combined.

The boat is made by having the bottom to the extent of the boards beside the keel to the width of three feet from bow to stern replaced by thick plate-glass, set inside of a railing so that the glass cannot touch the bottom; even if it did, the observer looks down through a well, his

A GLASS-BOTTOM BOAT

AVALON BAY, SANTA CATALINA ISLAND

THE KELP BEDS AS SEEN THROUGH THE GLASS-BOTTOM BOAT, SHOWING THE VINES AND HALIOTIS SHELLS

SCENE THROUGH THE GLASS-BOTTOM BOAT, SHOWING BLACK AND WHITE SEA FLOWERS

elbows comfortably resting on the padded edge. As the boat moves slowly along, every object on the bottom can be distinctly seen, as the glass magnifies it. The best view doubtless is had from the small boats, as they can go well inshore, but both have their advantages.

The small army of men or skippers each has his individuality, and while their zöology is not by the card, it is original; and as that of the average voyager is rather hazy, it makes little difference whether a sea-hare is described as an insect, as the public long ago accepted the dictum of Montgomery, the poet, that the coral animal is an insect, and all the zoölogists since have been unable to change their opinion. The object lesson of the trip is a very valuable one, however, and a better or more fascinating way to study marine zoölogy could not be designed, as a marvelous horde of strange and beautiful creatures are passed in review.

SURROUNDED BY A FOREST OF KELP

The submarine scenery is particularly attractive here. The entire island, nearly sixty miles around, is lined with a forest of Nereocystis, or kelp, a huge vine whose leaves rise and fold and unfold in the water, the abiding place of countless animals of all kinds. This fringe rises in deep water ten or twenty feet from the rocks, and inshore are myriad forms of algæ of various colors, to which the skippers have given fanciful names, as the Yosemite, the Grand Cañon of the Sea, the Great Divide, etc., all of which adds to the piquancy of the amusement.

The divers often follow the boats around, and for a bit will dive for haliotis shells, which doubtless they have planted, though almost every rock has its living shell. As the boat moves over the shallow water of Avalon Bay, exclamations come quick and often, as one scene melts away and another appears, and the entire range of color is exhausted before the trip is over.

The fauna of this region is particularly interesting, as many of the animals seen are peculiar to it. The accompanying illustrations are from photographs taken under the writer's supervision and show the various animals seen through the glass-bottom boat, alive and under water. Care was taken to show the natural environment as nearly as possible, and they are the first photographs of the living Pacific Coast fishes ever made, each one being the result of repeated trials and many failures. The kelp itself forms a beautiful picture, its rich olive hue when it catches the sun looking not unlike a great band of amber against the vivid torquoise of the water, as deep water is so near the shore that often one can dive into blue water from the rocks.

A common form in the weed is the giant California star-fish, its white tubercles against the pink or red surface making it a striking figure against the green, red, or purple weeds. Near it will be seen the large California sea-cucumber lying on the rocks, prone and motionless, and near by the long-spined sea-urchin, very similar to the one of the Florida reef, though not so long. With it is a small, pure white sea-urchin from deeper water, a charming contrast to the green weed that is in constant motion, waving and undulating in the waves that affect even this quiet bay.

THE HIDEOUS OCTOPUS

We now drift over a rocky area where the water appears to be a pale blue. A reddish-yellow crawfish waves its serrated spines back and forth from a crevice, and passing before him is a hideous octopus, searching for crabs or anything that it can lay its tentacles on. This, without question, is the most fascinating animal to be seen through the glass window. Timid, constantly changing color, hideous to a degree, having a peculiarly devilish expression, it is well named the Mephistopheles of the sea, and with the bill of a parrot, the power to adapt its color to almost any rock, and to throw out a cloud of smoke or ink, it well deserves the terror it arouses. The average specimen is about two feet across, but I have seen individuals four-

GIANT CALIFORNIA STAR-FISH: SANTA CATALINA

teen feet in radial spread, and larger ones have been taken in deep water offshore. The strength of the octopus is extraordinary. Several kept in confinement by me have almost succeeded in holding my hands despite all my strength.

A relative of the octopus, the squid, is often seen here ten feet long. One kept alive by me for a while weighed two hundred pounds and was eleven feet long, presenting a marvelous flashing of colors over its body that could only be compared to chain lightning.

In the crevices of the rocks you may

CRAYFISH AND STAR-FISH

catch brilliant flashes of vivid red. This is the Garibaldi, a fish resembling the angel fish of Florida to some extent, but peculiar to this coast. It is very sociable, and comes out, eyeing the boat and doubtless familiar with the strange double row of faces that are looking down at it. The adult Garibaldis are one color, a brilliant golden red, but the young, which can be seen in the crevices, are dotted with brilliant blue, and the skipper calls them "electric fishes" and tells you the spots give out light.

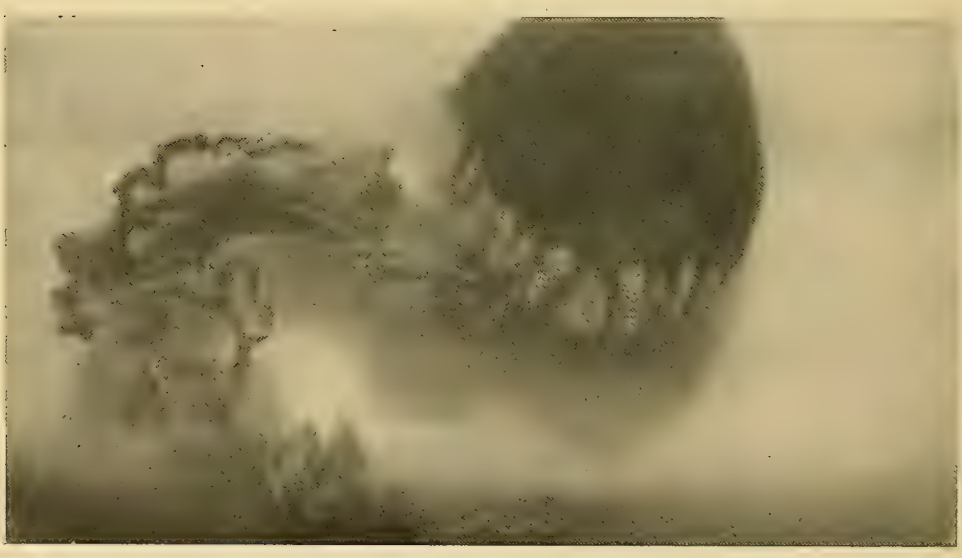
PHOSPHORESCENT JELLY-FISH

Suddenly the boat passes over a white and pink jelly-fish. It is two feet across the disk, from which drifts away a wonderful fluted mass of shrimp-pink tentacles ten or fifteen feet long. Some of these jellies have been seen with tentacles from twenty to forty feet in length, a veritable comet, and at night a phosphorescent meteor.

Near by is another jelly something like this, but almost black—a deep maroon in color. The skipper holds the boat over them, and every motion of the curious creature is seen as it opens and shuts and pumps its way through the clear water. Countless small jellies fill the water at times, most graceful shapes; some that have never been described, others rare elsewhere are common here. Such is the Pyrosoma, one of the luminous compound Ascidians. It is a barrel-shaped animal with one end open. Specimens six feet long have been seen. Dr. Moseley, the English naturalist, describes one which he placed on deck, writing his name on it and seeing the letters come out in lines of fire. The Bay of Avalon is sometimes filled with them, and now we see them pumping their way along beneath the window-like crystal vases, with other luminous forms, as the giant Salpa, the latter now singly, now in chains, among the most beautiful of the phosphorescent animals.

A striking fish is the sheepshead, with black and crimson bands in the male, a gray in the female, shown here. The

THE GOLDEN ANGEL FISH



BLACK JELLY-FISH, PHOTO FROM LIFE, IN THE WATER

THE FEMALE SHEEPSHEAD

young are attractive little fishes splashed with blue.

At times, after great storms, the voyager, peering down through the glass window, sees strange and weird animals new to science or so rare as not to be seen alive by one in fifty thousand. Such is the deal fish, seen lying on a weed, about three feet long, a band of purest silver; when it moves or swims it appears to undulate like a ribbon. Specimens of an allied form twenty feet long or more have been found near here. The fish lives in the deep sea, doubtless, and only at rare intervals comes to the surface to be seen or caught in the nets of the fishermen.

THE PAPER NAUTILUS AND WONDERFUL SEA ANEMONES

If we are very fortunate we shall see the paper nautilus, the most beautiful of all the mollusks, which forms a dainty capsule or shell that has for ages been a model of all the most beautiful of animal creations. If we are again fortunate we may also see the animal leave the shell and move about, flushing a pale red, now a vivid blue. This is the animal that is supposed to raise its sails and float on the seas, "a thing of beauty, a joy forever." It is sad to break up these delightful fables, but the sail merely clings to the shell, and the shell is merely the egg-case or float for the strange creature.

Drifting along, the rocks are now seen to be covered with seeming flowers. They are sea anemones, here of the largest size, virtual giants, and when open with all their tentacles expanded, the flowers of the sea certainly, in shape and color. In these big anemones, which are cousins of the corals, a little fish lives, darting into the mouth and living in the stomach or intestine of the animal. A long, slender fish also lives in one of the sea-cucumbers which we have always in sight, the trepang of the Chinese, and in Malay an article of export. Here, also, are small star-fishes, some like snakes, uncovered by the waves as they come slowly in. Near them, its head projecting from the crevice, is the moray, a big eel-like fish four feet long, with fangs that

GIANT JELLY-FISH (SEE PAGE 767)

GIANT SEA ANEMONES

call to mind the rattlesnake—a ferocious fellow that strikes like a snake and is to be avoided.

Some of the fishes here, as the Indian-head fish, appear to have outdone themselves in the richness of their coloring—blazing in blue and reds, while the dorsal fins are really plumes dashed with blue or black. The eye of this fish is large and a vivid blue. Over them are two antennæ which move about in a comical way. Crawling in the weed are big crabs, gigantic pseudo-spiders, and by examining the kelp and other weeds carefully

THE INDIAN-HEAD FISH

SPOTTED KELP FISH (SEE PAGE 777)

curious crabs are found which mimic them so exactly that some experience is required to see them.

FISH THAT MIMIC THE LEAVES AND ROCKS

Many of the fishes seen through the window are mimics of remarkable cleverness. When the slow movement of the water overturns the kelp and brings it back again, we may see a green fish about a foot long, with a long frilled dorsal fin. This is the kelp fish. For protection it mimics the leaf; and, not only this, you note that it hangs in the water just like a leaf, head up or down, so that a novice would never see it unless his attention was called to it by the attentive skipper, who perhaps has a name for it that would make the lamented Linnæus turn in his grave

Drifting along, the passenger in the glass-bottom boat often sees the large pelagic fishes, as the yellow tail, white sea bass, or the giant black sea bass, which weighs five hundred pounds and lives in the kelp beds of the channel islands. Sharks are also sometimes seen, and on the bottom, coiled up in some snug harbor between the rocks, may be seen a very interesting shark called the Catalina Port Jackson shark. It is about two feet long, with a spine before each dorsal fin. It is sluggish and feeds on crabs at night, and lays a peculiar corkscrew-like egg, shown with the young in the photograph. For years this shark was supposed to be extinct and known only by its fossil spines; but finally some one went to Port Jackson, Australia, and found them alive; then a species was discovered on the Californian coast. It is one of the common catches in traps at the islands, and its curious eggs are sold as curiosities.

On the bottom we see rock-like objects which prove to be sculpins, so mimicking the rocks and stones that at times it is impossible to distinguish them, as they are covered with curious barbels, which look like weeds, and are black, red, yellow, and white, perfect imitations of the rocks on which they lie, ready to take any kind of a lure. If a panorama had been ar-

A YOUNG PORT JACKSON SHARK AND EGGS. NOTE THE PECULIAR CORKSCREW-SHAPED EGG (SEE PAGE 773)

DEVIL FISH: SANTA CATALINA ISLAND. SEEN THROUGH A GLASS-BOTTOM BOAT

THE MIMIC SCULPINS IMITATING ROCKS

THE BLUE-EYED PERCH

ranged it would not appear more artificial, as at every move of the glass-bottom boat something new is seen through the window, as though prearranged. The scenery changes every moment, and as there is a slight ground swell, just sufficient to lift the curtains of the weed and move them to one side, then back again, strange things constantly appear. Now the vista is green. Presto! the tidal scene-shifter makes it purple of a gorgeous hue; then comes the cavern of the sea, "In gulfs enchanted where the Siren sings," faced with a most delicate green, in which swim blue and gold fishes.

BLUE-EYED PERCH

Drifting out a little, into water thirty feet deep, we see that Santa Catalina is a big offshore Sierra, as we can now look down the precipitous slopes into water of an indigo-blue shade, the most exquisite blue imaginable, with a background here and there of dim shadowy shapes. Prichard, the well-known submarine artist, has gone down in diver's armor at Tahiti and painted such scenes, and only those who have been divers or who have gone on a cruise on a Santa Catalina glass-bottom boat can appreciate their real beauty. Lying on one side is a mass of peculiar mazarine blue. In a moment we make it out as a school of blue-eyed perch of California, a fish about a foot long, with eyes like torquoise. In the peculiar light that sifts down through the kelp they appear blue, and are all headed in the same direction and lying near the bottom.

In mid-water are countless kelp fishes, graceful swimmers, while below them there are others still more radiant in yellow, white, brown, and red. They lie upon the rocks as shown in the photographs. Sometimes a shark sails slowly along with its remoras or sucking fishes following or fastened to it. They will often wander away and look curiously up into the big window down into which peer scores of faces in a row.

The big glass-bottom boats, which hold one hundred passengers, travel up and down the coast. They visit the sea-lion

rookeries and allow the voyagers to photograph the animals. It may be chronicled that a new and valuable ally to science education has been established in California in the boat with a glass bottom, through which naturalist or layman may observe animals in their habitat and note their habits unconstrained.

EXPLORATIONS IN CRETE

By Edith H. Hall

SINCE the island of Crete passed out of the control of Turkey, now nearly a decade ago, it has offered a field of exploration unparalleled for richness even in Ægean lands, where ancient remains abound. Under the Turkish regime a thorough-going exploration of the island was impossible, but since the flags of the Powers first waved above the Venetian walls at Canea; since the Italian gendarmes came to train the now efficient Cretan police, and since the power to grant permissions to excavate passed into the hands of courteous and enlightened officials, Crete has been the scene of a remarkable series of discoveries.

To the traveler arriving from Greece the island of Crete presents aspects that are exotic and foreign. The heavy Venetian walls, it is true, which greet the eye as one approaches the harbor of Candia differ only in extent and splendid preservation from the Venetian walls at Nauplia or Corfu. But the costumes of the boatmen who row the visitors ashore are Turkish; among the loiterers on the quay are Bedouins and negroes; and the first glance up the narrow, twisting, and roughly paved streets of a Cretan town will discover a Turkish balcony or a minaret and mosque. Even so, in the third and second millenniums B. C., the island must have seemed strange and foreign to a traveler from the north, for in that remote epoch also Crete was in close communication with Phœnicia and Egypt, and absorbed more elements of these civilizations than did the mainland; but of this later.

The archæologist who excavates in Crete enjoys a brilliant background for his work. When he sees for the first time the picturesque Turkish sailboats, with their flame-colored sails, rocking beneath the Venetian mole; or the colors of the market-place, where the venders wash their green stuff in the old fountain; or the fields bright, now with pink and purple anemones, now with yellow oxalis and scarlet poppies, he exclaims, "Why do the artists forever paint Capri and Sorrento and never paint this?" But when he has lived in the island some time, either renting for a trifle a house in Candia with a pebbled court and garden all his own, or living in some country village, where he learns to marvel at the unspoiled refinement and courtesy of the islanders, he is likely to offer a prayer of thanksgiving that Crete is as yet unknown to the tourist throng—that it still remains a rare prize enjoyed by occasional travelers and a handful of archæologists.

It is not an exaggeration to say that one cannot turn the soil of Crete without bringing to light potsherds—relics of the prehistoric, the Greek, the Roman, the Byzantine, or the Venetian civilizations which have flourished successively on Cretan soil. But generally these fragments of pottery are coarse, undecorated, and badly broken, and are separate from house walls. To find good specimens of well-finished decorated pottery, together with the remains of buildings, is the aim of the archæologist, and to find such remains dating from the prehistoric period is today his highest ambition, for scholars bent on solving the problems of early Ægean civiliza-

tion and Roman and even Greek remains comparatively uninteresting. The spirit of Darwin has penetrated even to archæology, and the excavators of the present have a passion for beginnings.

It is against the law in Crete to unearth antiquities without permission from the government, and peasants who by chance come upon ancient remains in working their olive orchards or vineyards are bound to report such discoveries promptly to the officials of the museum at Candia. In this way are occasionally found sites for excavating, but these sites go chiefly to the Greek archæologists. Foreigners must find for themselves their own places to dig. This they do by riding on horseback from village to village and inquiring everywhere if antiquities are found there. In response to this appeal the peasants produce all sorts of objects, from Mycenæan seal-stones of the second millennium B. C. to tops of modern beer bottles. The visitor next goes with the peasant to the place where the seal-stone, or whatever it may be, is found, and if he is lucky his first trial trench will discover an ancient house wall, and he will know that he is on the right trail, and will apply to the Cretan government for permission to conduct systematic excavations.

Such is the method used today. Ten years ago, when the island was first opened to scholars, the most promising sites, like that of the Knossos palace, were already known from the reports of peasants and the notices of travelers; and the archæologists who were so fortunate as to get these sites for digging, and whose operations in the island have lasted until now, generally have other possible sites for excavations in reserve about which they are often willing to tell to newcomers.

The number of men employed in excavations varies according to the size of the site and the funds at the disposal of the excavator, from ten to a hundred or more men. The majority of these are "basket boys," whose work it is to carry to the dump heaps the earth which is removed. Their wage is about twenty cents a day.

The most intelligent workmen are employed in loosening the earth with picks. They must be trained to watch with care for every scrap of pottery, bronze, or stone in the earth before them, and instantly, when they see that they are approaching a floor level on which vases rest, to stop using the pick and to work with a knife which every good workman keeps ready hanging from the top of his boot. Such workmen earn forty cents a day. Behind them are stationed the shovelers, who put the loosened earth into baskets, watching the meanwhile lest any small object be thrown away. Their wage is thirty cents.

Lastly, mention must be made of the men, or sometimes girls, who wash the pottery and pottery fragments. In some kinds of soil potsherds become incrusted with a hard formation which yields only to an acid solution. To counteract the effects of the acid, an alkali bath is necessary, and then a rinsing in clear water. During this treatment each vase or group of sherds must be kept quite distinct from its neighbors, for one of the fundamental principles of excavating is to keep an exact record of the contents of every room or given area and of the different strata within that area. This care is the result of the new scientific method of archæology which has grown up in the last thirty-five years. Excavators now dig not for spoils—as did the nephews of the popes in the fifteenth century, out of the desire to fill their villas and gardens—but for science solely. The objects found go, with a few exceptions, to the Candia Museum; only the "useless objects," so the law reads, may be exported.

To describe in brief compass the results of the last ten years of digging in Cretan soil is impossible. It would be necessary to take into account the work of Doctor Evans, of Oxford, in unearthing the palace of Knossos; of the Italian mission at Phaestos and other points in southern Crete; of the Greek scholar,

A CRETAN ROAD

CRETAN WOMEN SPINNING

MONKS OF GOMA MONASTERY, WHERE TRAVELERS ARE GLADLY ENTERTAINED

CRETAN CHILDREN

CRETAN BOY PEDDLING COOKIES

LARGE JAR AS HIGH AS A MAN, FROM THE KNOSSOS PALACE
This is now thought to be the kind of "tub" in which Diogenes lived

SCENE AT CRETAN FOUNTAIN

RED STONE LAMP FROM PSEIRA 1500 B. C.

OPENING CLAY SARCOPHAGUS OF 1400 B. C., CONTAINING SKULLS AND BONES

REMOVING THE LAST EARTH FROM ABOUT A VASE

GREEK FOREMAN, ARISTIDES, MENDING A VASE

CRETAN GIRLS WHO WASH THE POTTERY

VENETIAN FOUNTAIN IN THE SQUARE OF CANDIA, CRETE

STAIRS IN PHAESTOS PALACE

Mr Xanthondides, at Koremasa and other sites; of the English scholars from the British school at Athens, at Zakro, and Palaikastro, and lastly of the American excavators, Mrs Harriet B. Hawes and Mr R. B. Seager, the former at Gournia, the latter at Pseira and Mochlos. Between them they have excavated palaces, towns, and cemeteries. The palace of Knossos alone "is a more complex and extensive series of courts, rooms, and labyrinthine passages than has been met with anywhere on Greek soil."

Further, the recent investigations in Crete have evolved a system of chronology for this prehistoric era of 3500-1200 B. C.; they have shown that a high degree of artistic skill in decorative art and modeling had been attained in that remote epoch; that a system of writing was in use; that out of the hardest stones graceful vases were cut; that jewelry no less beautiful than that of the Alexandrine period was made; that boats plied frequently to and from Egypt, exporting and importing wares; that men lived in houses two and three stories high, equipped with baths and drains, and well-lighted rooms opening into sunny courts and commanding pleasant views.

The results of these explorations are adding a new chapter to history, or rather they are turning legend to history, for those who read the reports of the Cretan excavators, especially those of Doctor Evans, will not find themselves involved in the dry and dusty discussions of an antiquarian, but, as a writer in Crete has recently said, they will be carried back to the "glamour and romance of first fairy stories" about the Minotaur and the Labyrinth.

No better impression of the dramatic quality and thrill of Cretan discoveries can be given than by the following quotation. Doctor Evans has just discovered the fresco of the Cupbearer in the Knossos Palace, and writes in his first report:

A CRETAN MOUNTAINEER

"The colors were almost as brilliant as when laid down over three thousand years before. For the first time the true portraiture of a man of this mysterious Mycenæan race rises before us. There was something impressive in this vision of brilliant youth and of male beauty recalled after so long an interval to our upper air from what had been till yesterday a forgotten world. Even our untutored Cretan workmen felt the spell and fascination. They, indeed, regarded the discovery of such a painting in the bosom of the earth as nothing less than miraculous, and saw in it the 'icon' of a saint!"

THE AFGHAN BORDERLAND

By Ellsworth Huntington

Part I: The Russian Frontier

At the present day, in spite of the boasts of civilized man, five important regions of the globe still remain practically closed to him. Two are the cold polar regions; a third is the huge dry desert of southwestern Arabia; a fourth is the fever-stricken interior of the great island of New Guinea; while the other three are the countries of Nepal, Tibet, and Afghanistan, among the lofty mountains and cold plateaus of the center of Asia.

In all seven cases extreme conditions of geographic environment are the cause of the exclusion of civilized man. In the polar regions and in the vast unexplored portion of Arabia extreme conditions of temperature or of aridity are in themselves enough to prevent the occupation of the country by man. In the other cases geographic environment accomplishes its function of exclusion in part directly, by making the regions difficult to traverse, and in part indirectly, by fostering in the inhabitants a spirit of exclusiveness and warlikeness, or by imposing upon civilized nations certain peculiar political conditions.

Among the closed countries of the world the degree of exclusiveness seems to increase in proportion to the political importance of the regions concerned. Thus there is at present no country which is more difficult to enter than Afghanistan, and none whose isolation is likely to break down so soon. This is due in the first place to the fact that the power which holds the Afghan mountains holds a strategic position of the highest importance in regard to India. Therefore England naturally has the most serious objection to any attempt by the Russians to obtain a foothold there.

In the second place, from Constantinople on the west to Manchuria on the east there is no place where the natural configuration of the country offers so easy a route from the Russian possessions in Asia to the southern ocean as through the western portion of Afghanistan. Consequently it is highly desirable for Russia to control this route, and she is naturally loath to see England supreme within the Afghan borders.

Thus it happens that both countries are willing for the present to leave Afghanistan in independence, and to allow the naturally wild and exclusive temper of the Afghans to have free play.

An account of the experiences of the writer upon the northwestern border of Afghanistan, where its territory adjoins that of Russia; upon the western border, where the country touches Persia, and upon the southwestern border, where English influence begins to be felt, will illustrate the degree of inaccessibility which now prevails in this most exclusive of kingdoms.

In the winter of 1903-1904 the writer, in company with a young Russian official, traversed the entire western frontier of Afghanistan. We did not desire to penetrate far into the country, but the study of certain geographic and geologic problems, such as the broad break in the mountains which gives such easy access to the country on the northwest, the great depression which determines the border between Afghanistan and Persia, and the fluctuations to which the enclosed lakes of Khaf and Seyistan are subject, made it highly desirable for the writer to be able to cross the frontier, while his Russian companion hoped to win fame and promotion by penetrating into some of the military secrets of the Afghans.

Late in November I started ahead of my companion from Askhabad, the cap-

TURKOMANS IN THE SANDY DESERT OF TRANSCASPIA DRAWING WATER FROM A WELL BY MEANS OF LEATHER BUCKETS

The water is poured into a wooden bowl for the horse to drink

A CARAVAN-SERAI IN THE DESERT OF EASTERN PERSIA

The view is taken through the gate and shows the curious crowd assembled to watch the departure of the foreigners

THE TOMBS OF MESHED, THE MOST HOLY PLACE IN PERSIA

The bodies of thousands of Mohammedans are brought here to be buried in the space around the shrine, which is literally covered with tombstones

ital of Transcaspia, and went by rail to Dushak, a little station a hundred miles to the eastward, whither our caravan had preceded me. There the Transcaspian railroad bends to the northeast to reach Merv, while our route led to the south-southeast, along the broad sloping plain of gravel at the northern base of the mountains which form the boundary between Asiatic Russia and the extreme northeastern part of Persia. The first day's march was short. The following morning a splendid red sunrise ushered in Thanksgiving Day, clear and bracing, as November days are apt to be in the dry Russian province of Transcaspia. All day the caravan moved slowly eastward—four men, five horses, and three baggage camels — strange, grunting beasts, whose long, pliant necks and awkward legs were oddly suggestive of huge picked chickens, especially when seen from in front.

During the four months of hard traveling in eastern Persia to which this day's march was the prelude, the caravan developed splendid efficiency, but as yet it was not well shaken together. We had spent an uneasy night, which began with a search in the dark for a camping place and for water, firewood, eggs, and milk, and which ended with a nightmare of a dragon licking his chops and writhing his coils about us. We awoke to find that one of the common incidents of camp life had occurred—the camels had gotten loose, and in their attempts to eat the leaves of the cultivated poplar tree above our tent were kicking the tent ropes with their crooked legs and setting their rubbery, compressible feet upon the pegs.

All day we saw no sign of man except the ruined mounds of the civilization of the past, and no sign of animals except herds of sharp-horned, slender gazelles browsing on the brown remnants of the sweet, meager growth of short grass which flourishes for a month or two after the rains of early spring. Once a herd of about twenty of the graceful fawn-colored creatures followed us for an hour out of curiosity, sometimes coming within a hundred yards of the path, so that we could see every movement as they gamboled and played under the influence of the crisp fall air, and sometimes chasing one another in great circles or dashing off for half a mile, so that nothing could be seen of them except white tails bobbing up and down as the graceful creatures leaped over bush and stone. For them a run of twelve or fifteen miles to a drinking place was a matter of no consequence, and therefore they could live in the dry plain from which slow-footed man is excluded for lack of water.

Toward sunset signs of the presence of underground water appeared, and soon we came upon sheep and camels grazing amid the tamarisks of a broad, shallow valley wherein no stream was to be seen, but only a few slightly brackish wells and a disorderly group of round Turkoman tents, some of them made of gray felt and others of reeds plastered with mud. Not far away, upon a gravel slope, a cluster of low, neat buildings, with whitewashed walls of mud and stone and roofs of tile, presented a marked contrast to the slovenly Turkoman structures.

Sturdy Cossack sentinels, in long woolen cloaks and huge sheepskin caps, were pacing to and fro, and stopped us sharply as we approached. An American, even though accompanied by a uniformed Afghan and Turkoman who were enlisted in the Russian frontier army, must show very good reason for approaching a military post in the vicinity of turbulent Afghanistan. Only the closest scrutiny of my papers, signed by the military governor of Transcaspia, convinced the sergeant who was temporarily in charge that I was not a spy whose arrest would bring him much credit. Once convinced, however, he was a true Russian in his hospitality. He had not much to offer, for the quarters and provisions of his absent superior were not at his disposal. The best that he could do was to allow me to share with himself and a corporal a cold, stone-floored sleeping-room.

TWO PERSIAN FAKIRS, SUPPOSEDLY HOLY MEN, WHO GO ABOUT SINGING, DANCING, PLAYING, AND BEGGING

AN AFGHAN SOLDIER IN UNIFORM

A VILLAGE AND IRRIGATED FIELDS ON TERRACES IN EASTERN PERSIA

PLOUGHING WITH HUMPED BULLOCKS AND A WOODEN PLOUGH ON THE BORDER OF AFGHANISTAN

A POVERTY-STRICKEN PERSIAN FAMILY CROUCHED BESIDE THE MUD WALLS OF THEIR HOUSE INSIDE A HIGH MUD WALL PUT UP FOR PROTECTION AGAINST AFGHAN BANDITS

A GROUP OF AFGHAN NOMADS

Dinner that Thanksgiving night consisted of a first course of black bread, milk, and tea, followed at an interval of an hour by "borsh," a favorite Russian soup full of large pieces of potato, beet, and carrot, floating amid chunks of mutton. The sergeant and his comrades evidently suffered sadly from ennui; discipline was naturally lax in so remote and uninspected a post, and drunkenness and gambling were too common to excite remark. Yet, in spite of this, one could not help liking the patient, good-tempered Cossacks, for there was an air of strength and vigor about them—the attitude of a conquering race.

During the next ten days I visited other lonely frontier stations, the largest of which was Serakhs, a Turkoman town at the very northeastern corner of Persia. Here the "pristav," or local executive officer, when he heard of the presence of an American, insisted upon my becoming a guest in his pleasant home. It was most interesting to see how this educated, energetic young man and his girlish wife made the modest executive dwelling an oasis of European culture in the midst of the Transcaspian desert. The effect was marred somewhat by the tall Cossacks who waited on the table, did the cooking, and wheeled the baby in its carriage; but, as Mrs Pristav said, "A Cossack is the most careful kind of nursemaid, and, besides, we can't get any girls or women here."

At the military club, the social center of the community, the remoteness of the place was much more evident than in the pristav's house. As there was nothing else to do, every one, including the priest, gambled and drank. When the regimental band began to play, I fear my face must have shown my feelings, for an officer's wife who had lived in Germany and England remarked, plaintively, "Does it sound very badly? When I first came I used to think it sounded terribly out of tune, but now I can't tell whether it is right or not. I believe I like it out of tune."

At Serakhs I was obliged to wait several days for the young Russian official who was to be my companion in Persia. The time was well spent, for the chief of the Department of Agriculture of the province invited me to go with him on his annual tour of inspection to the pistachio region, fifty miles to the south, on the border of Afghanistan. Part of the way we went by wagon and part on horseback, riding Cossack horses belonging to our escort. Once we stayed at a post where the wife of the captain was the only white woman within forty-five miles.

Again we crossed into Persian territory, and were struck by the poverty and dilapidation of the Persian military posts, which are supposed to offset those of Russia. When told that certain men were soldiers in uniform, I could see that among their rags an occasional brass button was hidden, but otherwise the soldiers and the beggars looked alike.

We found the pistachios growing upon low, bushy trees on the slopes of the gently rising mountains which form the Afghan border. The tree is so resistant to drought that the Bureau of Plant Industry of the United States deems it one of the most useful plants for introduction into the arid regions of our own country. The Russian government derives quite a revenue from the sale of the wild crop to Armenian merchants, who employ Turkomans to gather the nuts.

A Russian servant, Mikhail by name, shared all my journeyings in the Afghan borderland. On the first day of his service he reported for duty hilariously drunk, a condition of which he appeared to be much ashamed when he was sober. When he came for orders in Serakhs the pristav's wife, who had no fear of wild Turkomans and was accustomed to Cossacks as housemaids, was quite frightened. "I thought he was a robber," she said, when she saw him come into the kitchen with his rough sheepskin jacket, high boots, tilted Turkoman busby of sheepskin, shaggy brown beard, and sharp blue eyes.

In spite of his appearance he was a most lovable, gentle man—faithful, resourceful, and honest, a good hunter,

A COMFORTABLE PERSIAN VILLAGER

A WELL-TO-DO PERSIAN FAMILY
The women and girls of the family would not let themselves be photographed or even seen

A SACRED PLATFORM DECKED WITH WOODEN BIRDS

This is carried in processions at the time of the great feast of the Shiah Mohammedans in mourning for the death of Hassan and Hussein, grandsons of Mohammed

A PERSIAN VILLAGE OF DOMED MUD HOUSES COVERED WITH SNOW. BACK OF THE HOUSES STANDS A ROW OF WIND-MILLS

and always ready for work except when he became drunk—in short, a typical frontiersman like those of the "Wild West" of America a generation ago. He belonged to a heretical sect much given to holding long meetings, at which first one and then another, and finally several at once, shout out prayers at the tops of their voices. His family and other co-religionists had been transported to the Persian border and placed there in colonies, partly to get rid of their disturbing presence at home and partly to form a cordon of genuine Russian settlements along the exposed frontier.

Everywhere along the boundaries of Asiatic Russia military preparations are strongly in evidence. Nowhere is this more noticeable than at the corner where Russian territory adjoins Afghanistan and Persia, for here, as has been said, lies the one easy line of communication between northern and southern Asia in the whole vast stretch from the Bosphorus to Manchuria. Evidences of the importance of the region are found not only in the numerous military posts and in the colonies established for military purposes, but in the railroad spur some one hundred and seventy-five miles long which, at a distance of about sixty miles east of Serakhs, runs southward from the Transcaspian Railway at Merv to the Afghan frontier at Kushka. The fact that I traveled on part of the railroad aroused much ire on the part of several Russian officers, especially an irascible black-bearded colonel, and I should have been arrested immediately had I not been the guest of an official.

In general, the officers to whom I had introductions were proud to point out the barracks and to tell how the soldiers were cared for, but took great pains not to mention the number of troops or guns. They could not conceal the fact that equipment for an immediate advance was on hand in case there should ever be occasion to invade Afghanistan; and one of them said with pride that the large storehouses from which I was warned away at Askhabad contained the rails, ties, and complete equipment for sixty or seventy miles of light railroad, which could be laid down at a moment's notice, to connect the end of the Kushka spur with Herat, the chief city of western Afghanistan. Others may have overlooked the importance of the break in the great mountain chains of Asia which occurs in western Afghanistan and eastern Persia, but the Russians realize that some day it will be one of the world's great lines of communication.

The attitude of Persia toward affairs in the eastern part of her domain may almost be neglected, so far as its practical results are concerned. On leaving Serakhs, our first night in Persia impressed upon us the contrast between the business-like methods of Russia and the slipshod Persian way of doing things.

Arriving at Zorabad after sunset, we stumbled through the dung-heaps which, by courtesy, are called streets, and arrived at the wretched house of Mehemet Yusup Khan, the redoubtable chief of the three or four soldiers—nominally thirty—who are supposed to defend this frontier town against the Russians and Afghans. The floor of the single apartment was about two feet below the courtyard in which the horses were stabled. The furniture consisted of a few bags hung on wooden pegs driven into the mud walls, and a few dirty felts and bags that partly covered the floor, also of mud. The sooty roof of the apartment was nearly seven feet above the floor, but such spacious dimensions were too high for the door, before which one was obliged to stoop low to get through its four feet of height.

The only window was a round hole about a foot in diameter, which was filled by half a dozen fowls that had taken refuge there from the cold December air, and that helped to lessen the draft on the people inside. Such, at least, was my thought until sunrise, when a boy walked unceremoniously into the room, and, picking up the sleepy hens, put them out into the cold through the door. The window was not a window at all, but merely a niche in the thick wall.

Throughout our stay in eastern Persia we everywhere found conditions much the same as in Zorabad. Poverty is the rule, and with it go shiftlessness, lack of neatness, lack of ambition, and vices such as opium-smoking. It hardly seems fair to condemn the Persians for these things. In other parts of the country conditions are much better. In the eastern half of Persia, however, there is so little rainfall that no crops can be grown except in a few pitifully poor oases. No one can hope to prosper greatly, no matter how hard he may work. Therefore the inhabitants stagnate and play no part in the present history of the country except as pawns to be harried by the Afghans, cowed by the Russians, or cajoled by the English.

WITH THE MONKS AT METEORA: THE MONASTERIES OF THESSALY

By Elizabeth Perkins

THERE is a legend, perhaps it is history, that there was once a ruler in Constantinople who disliked his brother and wished to banish him to the remotest corner of his kingdom. Consequently the monarch built a monastery on a well-nigh inaccessible mountain in Thessaly and founded a brotherhood, about four hundred years ago, in what seemed to be the uttermost corner of the earth.

The monastery was called "Meteora," meaning "domicile of the sky." After the original was built, twenty-three others grouped themselves around and were inhabited for awhile. They were, however, finally abandoned, with the exception of three which are still in use.

To reach this settlement one can go directly from Athens by train in thirteen hours, for the railroad has been lately finished; or one can cross Thessaly in seven hours by train from Volos.

The season of good weather commences in April, when the mountains are green and yellow with gorse and the sun shines almost continually. Earlier there are apt to be heavy rains, and the spring thaw causes a mist to rise from the frozen mountains which obscures the view, while the snow, melting into the earth, makes mud one or two feet deep and traveling on horseback is almost impossible.

If, however, one is fortunate enough to hit the last of winter, when the sun shines and the mountains are still resplendent in their dazzling whiteness, then one sees them in all their glory. The rocky eminences on which stand the twenty-four monuments of man's erstwhile habitation seem to forbid nearer approach, and yet they lure the adventurer to them by their danger.

The seven hours' trip across the plains of Thessaly to the town of Kalabaka is most enchanting. Range after range of hills roll up from the plateau. The foothills in winter are powdered with snow, as though an angel had shaken the down from his wings; the higher hills are whiter and bleaker, and the highest hills are as pure as the drifting clouds into which they seem to melt and disappear into highest heaven.

On the plains flocks of goats and sheep, attended by their shepherds, are spread so numerously over the land that mushrooms in a field never appeared more abundant. The shepherd himself is a picturesque person. His legs are encased in long, white leggings, ending in pointed, turned-up shoes adorned with tassels. A sheepskin hangs from his shoulders and a staff with crook is carried in his hand.

Our train crawls over the hills and across the plains at the rate of ten miles an hour, and the sheep-dogs run barking

BARLAAM, WHERE WOMEN ARE NOT ALLOWED AND WHICH CONTAINS A REMARKABLE BYZANTINE LIBRARY
Access by the rope bag, also by the frail and swinging ladder, built against the rock. The ladders and rope show in this picture, but not the bag

by its side; indeed, for a short distance they often outpace the train.

The villages, invariably set back from the railway, are far better to look at in the distance, for the stucco houses are not attractive near to; but their flat, red roofs add a pleasing touch of color to the middle landscape.

Occasionally a Greek priest, with long beard, long hair, and long garments, rides by. His high hat and his large cross indicate prominently his calling, and, if he is not in too great a hurry, a pedestrian may stop him, kiss his cross, and be touched on the forehead with a little switch, presumably dipped in holy water, and the sinner obtains absolution for the day.

We left the train at Kalabaka, and there took horses and guides to climb to the high-built monasteries. For three hours the horses had to pick their way over hillsides where, in the month of February, no trail was visible.

The snow grew deeper as we mounted higher, and the coating of ice on the rocks made our progress slow and slippery. Up the bed of streams we went, fording the rushing waters, which bespoke spring freshets, and quite suddenly we came upon a rock formation so awe-compelling from its immense height and forbidding steepness that Doré could have imagined no more formidable bulwark.

Andromeda might have been chained to one of these sheer rocks, and the eagles that swoop, and dip, and circle among them could have been the only thing to reach her, until Perseus came to set her free. In those days the valley was evidently a body of water and could easily have harbored a monster of the deep. Now a river winds along, like a shining thread, with wide sandy banks, that indicate the presence of a wider sheet of water not so very long ago.

As we looked in wonder at one detached colossal pillar of stone, we discovered on its seemingly unattainable summit a building! This habitation of man, half natural rock and half artificial, seemed most extraordinary. Our guides drew attention to the higher precipices, and as we grew accustomed to their outlines we saw, on all sides, monasteries tucked into the ledges of the perpendicular walls. They are not all inhabited today, but they are there, bearing testimony that man has climbed, and built, and lived on crags that seem impossible for goats to climb.

The first abode of the contemporary monks is Barlaam, which is said to contain a wonderful Byzantine library; but entrance to this monastery is barred to women. However, the cloistered brothers are not forbidden to look at passing femininity, even if they cannot harbor them, for they called out to us as we passed below them on the mountain side, and we answered back, "Good day." An hour further on we caught sight of another monastery, Trinity, and there upon arrival we were allowed to enter.

The whole of the west plain of Thessaly lay at our feet, and the white mountains of the Pindos range rose rugged and imposing before us. At the base of the rock on which Trinity is perched, like an eagle's nest, our guides hallooed and beat with a stick on a tin can, found in the bushes. Soon an answering call came back, and over the precipice, some three hundred feet above us, the peering faces of several monks were seen. Then something serpentine flew into the air, and as it dropped perpendicularly we saw dangling from a coil of rope what looked like a small fish net. Down came the cable until it touched the earth at our feet, and the fish net proved to be a large-sized rope bag, which opened and spread out flat on the ground.

One at a time we were invited to step into the middle of this net and squat, Turk-fashion. The edges were gathered together onto a large iron hook, a shout was given, and the net soared upward, while its occupant felt somewhat like an orange at the bottom of a market woman's bag.

The ascent takes just three minutes. Occasionally the openwork elevator swings into the rock with a slight bump, but the monks at the top wind the windlass slowly, and the bumping doesn't

ANOTHER VIEW OF BARLAAM AND THE PINDOS RANGE OF MOUNTAINS

Photo and Copyright by Underwood & Underwood, New York

MONK ASCENDING TO MONASTERY OF SAINT BARLAAM IN A ROPE BAG DRAWN BY A WINDLASS (SEE PAGE 801)

TRINITY, WHERE WOMEN ARE ALLOWED AND ALL VISITORS ARE DRAWN UP IN A ROPE NET

VIEW OF THE ROCKY FORMATION AND AN ABANDONED MONASTERY
Note the cultivated fields in the valleys

hurt, but as a compensation the view grows more beautiful every second. At last the top was reached. There was a final swing outward, to get a rebound inward, several pairs of hands were outstretched to pull the net over to the platform, and then came a drop onto the stone floor! The hook was detached, the meshes opened, and the passenger helped to her feet by the black-robed brothers. They all gathered around with words of welcome and hands ready to be shaken in greeting.

The first place visited was the chapel. The youngest monk, with full red beard and hair twisted into a psyche at his neck, acted as *cicerone*. The others straggled on behind. The small chapel was Byzantine in form and in decoration. Frescoes covered the walls. Silver lamps hung from the ceiling and before pictures of saints crowned with silver and many having silver hands extended in blessing.

With many apologies this brother showed us his cell. A studded door which led to it was so low one had to stoop to look in. Its walls were whitewashed and its window grated, but the bed, though narrow, had a gay chintz cover, as did also the table, and around the wall was a shelf of books. Several photographs of other monks indicated his desire for decoration, and even suggested that could we have looked into more guarded places we might have found souvenirs of sister or erstwhile sweetheart.

Washing arrangements there were absolutely none. The visitors' parlor and the room reserved for guests to sleep in were scrupulously clean. As we were writing in the visitors' book a lay servant entered with a tray bearing water glasses, liquor glass, and a glass of red jelly with spoons. We took a teaspoonful of jelly made from some wild fruit, and then the monk-made cognac. Both were delicious, and bore testimony to the fact that even monks, though barred from many pleasures of the world, cater to the pleasures of the stomach. All we had to offer in return for their hospitality were some American postcards.

The Flatiron Building caused much unintelligible comment, but also the perfectly understandable remark that "this must be the Meteora of America." Our red-haired friend also made us understand the superiority of the original Meteora in having a net bag to facilitate the mounting. Alas! we could not make *him* understand the greater superiority of an electric lift.

The oldest monk was very cross; nevertheless he took the postcard and stuck it in the frame of the patron saint which hung above the visitors' book, and when the next American writes his name therein he may gaze with amazement at his home monuments and think indeed that the world is small.

After having enjoyed their hospitality we finally bade our hosts goodbye and again squatted upon the net. When its meshes were gathered onto the hook and all made ready, there was a sensation of *goneness* as the final push was given and over the brink went net and passenger and below was three hundred feet of space.

Horses and guides were awaiting our return at the foot of the mountain, and we rode on to the monastery of Saint Stephen. This monastery is perched no lower than that of Trinity, but it is accessible by a bridge across a chasm. At the end of the bridge a nail-studded door was opened to us, and through a low-vaulted stable, where dogs, and pigs, and sheep, and goats evidently took refuge, we passed into a courtyard, and on the steps of the cloister stood another monk ready to receive us.

We had a letter of introduction to him, which told our intention of coming, and he greeted us with dignified cordiality.

The chapel was first visited, then the visitors' parlor, and finally we were shown our room for the night. Whitewashed walls tinted blue, grilled windows, an open fireplace, raised high from the ground and piled with firewood, and three iron beds offered us hospitality for the night.

We had the afternoon and evening before us and it promised to be a long one. When our guides and horses left us to

return to Kalabaka, we were alone with the monks, who spoke only their own language, and, like all Greeks, were not very quick to understand the universal language of signs.

Fortunately we had playing cards with us and we started "Canfield." Then we stopped, thinking it might be forbidden to the holy order and a breach of hospitality for us to indulge in the recreation. But the monk who acted as special host saw us and motioned us to continue. Then he drew up a chair and watched. Soon he sent for another monk who came hurrying in, smiling, and watched too. Then we offered to let the monks play, and they did with alacrity. They played for an hour, and then they taught us a game of their own—a very good one too, with excellent opportunities for gambling. Although they played with the assurance that bespeaks frequent indulgence, still no money passes through their hands save that which is used for the poor. There is little occupation in these monasteries for those in retreat, and they voluntarily go among the poor in the near country and do much to relieve them.

Saint Stephen's is said to have a good revenue from property it owns in Volos, and as the brotherhood is free to any who wish to enter, it must have a certain income to support even its few inmates.

Our supper was served by the lay servant, while a monk hovered near to see that we had all we wanted. A hot rice soup, cold chicken, hot fricasseed chicken, rye bread, and red wine should satisfy the most fastidious, and for a sweet dish we had a cake made of chestnuts.

The following morning we were bade adieu and given Turkish coffee before we left. On our way down the mountain we wondered who could have been the first man to climb the first peak to lay the first stone on a point where birds hitherto only had rested.

THE PREHISTORIC RUIN OF TSANKAWI

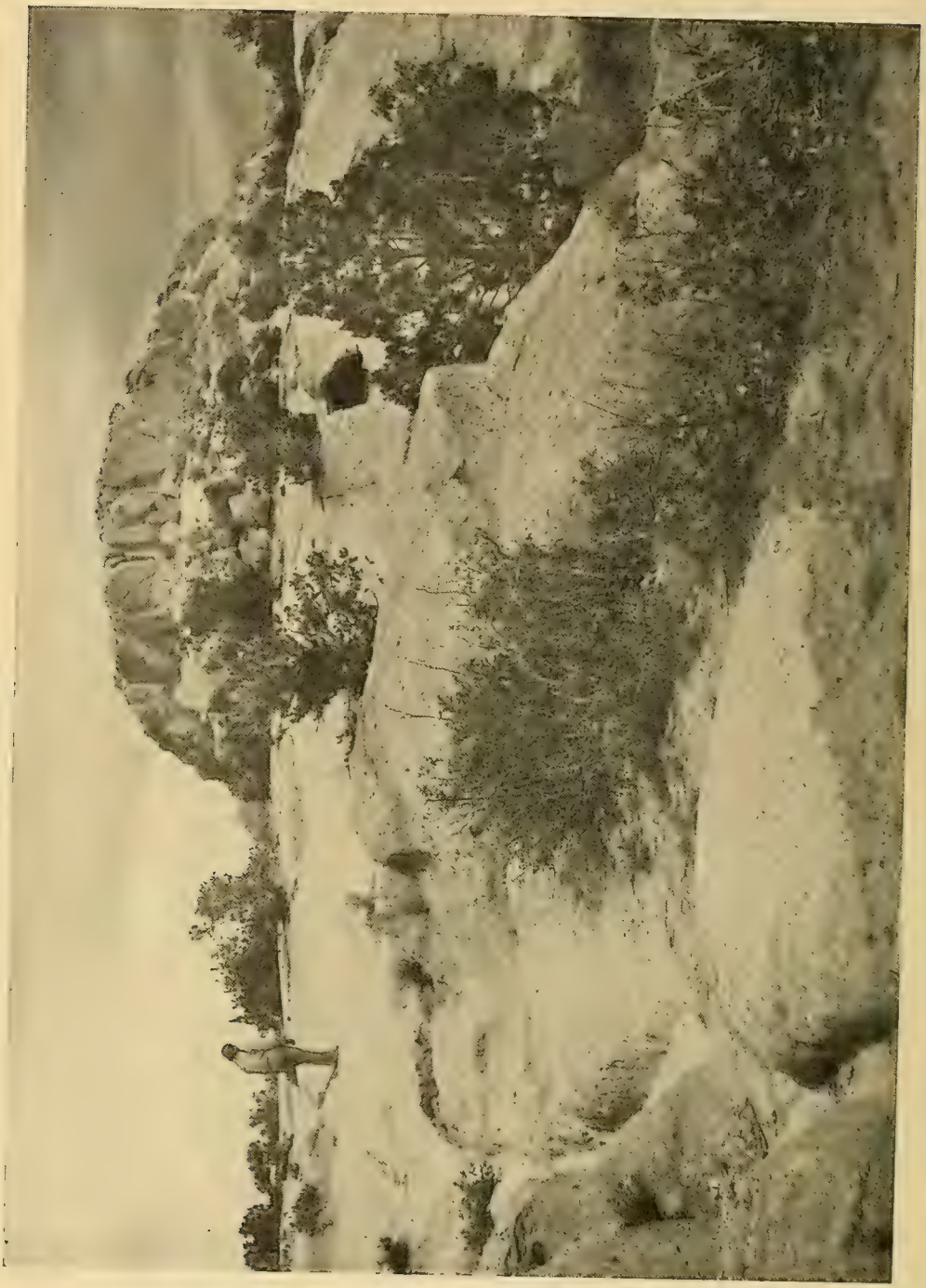
By George L. Beam

With Photographs by the Author

AMONG the several groups of cliff and cave dwellings in northern New Mexico which have been but recently brought to general notice, the most picturesquely situated is undoubtedly the village named by the Pueblo Indians "Tsankawi"—the equivalent in the Tewa language for "The Place of the Round Cactus."

This remarkable ruin is located about thirty miles northwest of Santa Fe, on the Pajarito Plateau, being reached from Buckman, a station on the Denver and Rio Grande Railroad between the former point and Espanola. At Buckman there is a substantial wagon bridge across the waters of the Rio Grande, and back over the mesa seven miles (the first two of which are consumed in ascending the steep side of the table-land from the river to the rim) is located the saw-mill of the Ramon Land and Lumber Company, which owns the great Ramon-Vigil Land Grant, containing many thousand acres of fine timber. From the saw-mill it is possible to make most interesting excursions in many directions among the ruins of the ancient habitations, many of which are in the immediate vicinity of the camp—in fact, the workmen have in some cases taken possession of the Cliff Dwellers' abodes for their present necessities.

Heading for Tsankawi, an hour's drive in a northeasterly direction brings one to the base of a long, irregular-shaped mesa, the sides of which are strewn with great sharp-edged rocks—the volcanic tufa which prevails throughout the region. On approaching this



ON THE MESA APPROACHING TSANKAWI, SHOWING SMALLER CITADEL-LIKE MESA IN THE DISTANCE
Ancient path in foreground worn one foot deep in the solid rock

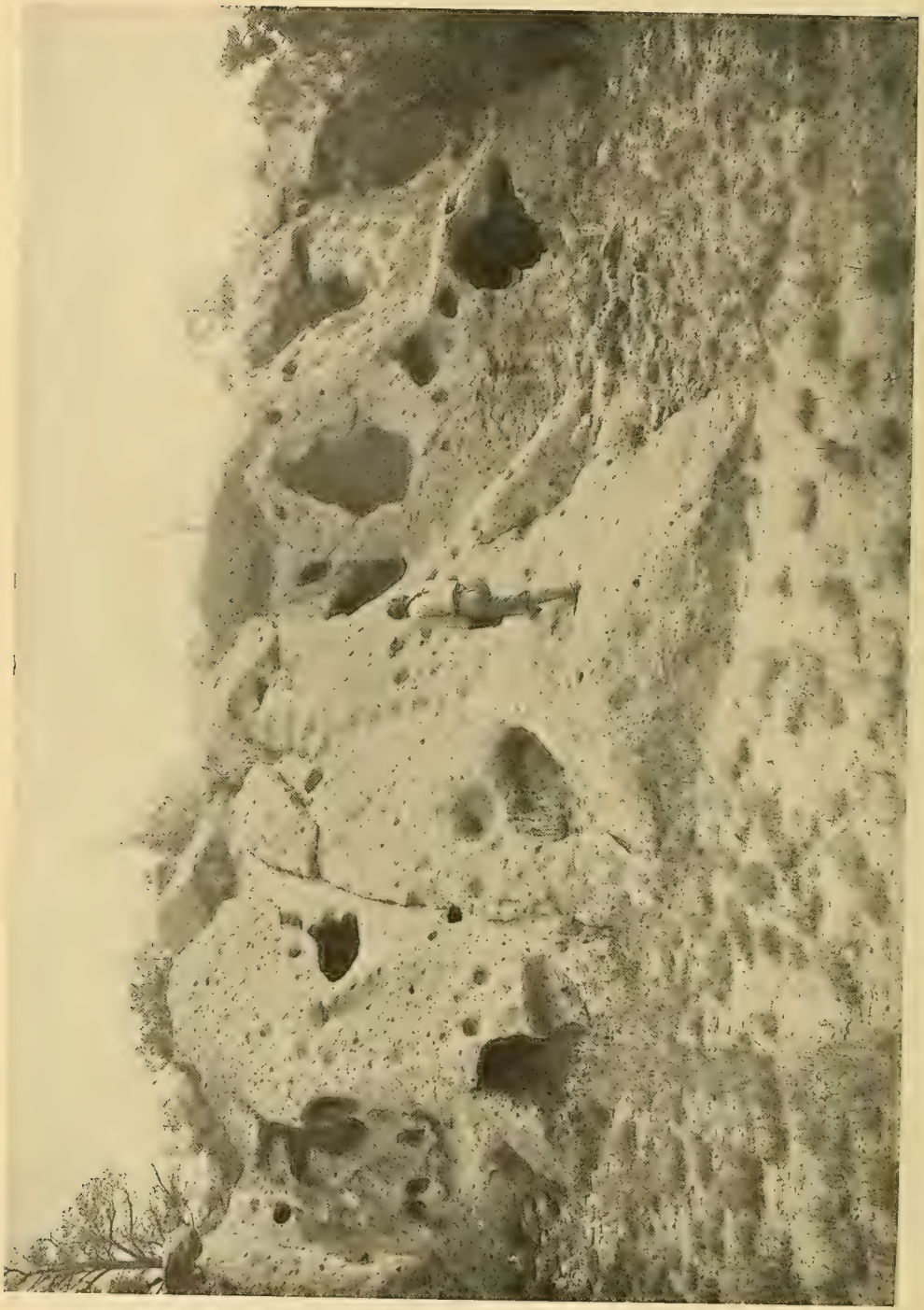
VIEW ALONG THE EDGE OF THE UPPER MESA OF TSANKAWI, SHOWING HOW THE ROCKS HAVE BECOME DETACHED AND FALLEN FROM THE SIDE

Some of their cutting is shown on large rock near center. Indian standing above passageway

PETROGLYPHS AT TSANKAWI AND ANCIENT PASSAGEWAY TO THE TOP OF UPPER MESA, WHERE ARE FOUND THE RUINS OF THEIR STONE DWELLINGS

RUINS OF ANCIENT PUEBLO ON UPPER MESA OF TSANKAWI

Looking westward; Jemez range in the distance. Very little excavation has been done here. Some graves have been opened at the left



NAVAWI, SHOWING CAVE DWELLINGS AND STEPS CUT IN THE SOLID ROCK
The town now called Navawi (Place of the Game Trap) is a close neighbor to Tsankawi

mesa from the west still another, but smaller, eminence is seen perched upon the larger, probably a thousand feet from its western extremity, occupying a most commanding position and forming a natural citadel.

As one advances, the caves on the sides of the mesa, created partly by erosion and partly by human labor, become more numerous, and upon reaching the summit of the first mesa a well-defined path is discovered, worn in places fully one foot deep in the solid rock by the constant tread of sandaled feet. To have accomplished this, the wearing process must have been carried on for a long period of time by a population of many hundreds—in fact, two of the most remarkable features in connection with these ruins are the enormous number of the dwellings and the evidence of continuous occupation for a great length of time.

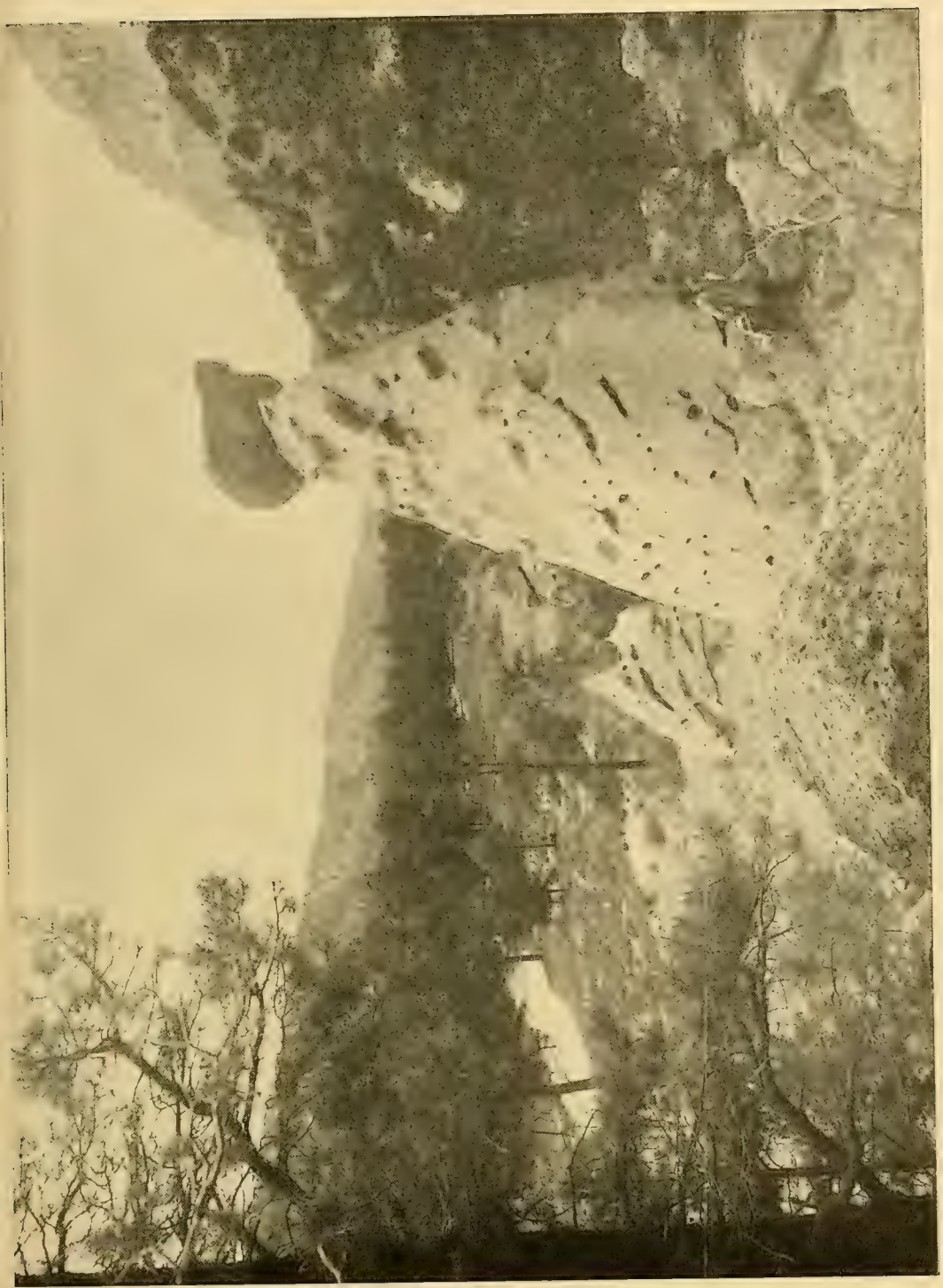
Following this trail, placing one's feet in the depression made in those bygone days, one is led to a great confusion of broken rocks, which appear to have been evidently shaken down from the sides of the upper mesa. Proceeding closer to the wall, the explorer is confronted by a large and most forbidding group of petroglyphs, or rock-cut pictures, representing human beings and animals in threatening attitudes, the principal figure having a substantial tomahawk in its hand. There can be no question that these rude carvings, which are cut to a depth of an inch or more, were so placed in order to frighten enemies away from the narrow passage which is located but a few feet further on, leading to the top of the mesa.

When one enters this passageway the almost impregnable character of the natural citadel above becomes still more apparent. The opening is about ten feet high, two feet wide at the base, and three feet at the top. Immediately after entering the cleft, a slight turn is made to one side, then several more turns in quick succession, and after a climb of perhaps twenty feet up a gradual incline (there are no steps at this entrance) the top of the upper mesa is reached. Perhaps nowhere in the cliff-dwelling region is there a better evidence of this ancient people's capacity for well-directed and persistent labor than is afforded by this very skillfully made passageway, hewn out of the solid rock with their crude tools—axes and hammers of granite, flint, or obsidian.

From the top of the upper mesa a most magnificent view of the great Pajarito Plateau, with its valleys, mountains, and cañons, is afforded, and one is still more impressed with the appreciation of the grand and the beautiful, which seems to have been second nature with these primitive people in the selection of sites for their dwelling-places. Westward is to be seen the Jemez range of mountains; far to the east is the Santa Fe range, while much nearer may be seen portions of the Rio Grande as it flows southward to the Gulf; and in the immediate vicinity are numerous mesas similar to that of Tsankawi, with deep cañons between. The entire landscape, viewed in any direction, is most impressive.

From the upper extremity of the passageway a path leads to the eastward for another thousand feet along the mesa, which grows gradually narrower until it suddenly widens out, and the ruins of the great pueblo (or mesa dwelling, as distinguished from the cave dwellings on the sides below) are presented to the view. Here the almost total destruction of all evidences of habitation forces upon one the conviction that the abandonment of the Cliff Dwellers' homes was due to some terrible calamity. Perhaps their fierce and implacable enemies (for such they must have been, considering the extraordinary means taken for protection), attacking in great numbers, overcame the sentries at the several stairs and passageways, swarmed up to the stronghold above, and massacred the inhabitants or drove them over the cliffs to the larger mesa below. Again, possibly an earthquake or volcanic disturbance forced them to abandon the homes which their forefathers had so firmly established many generations before.

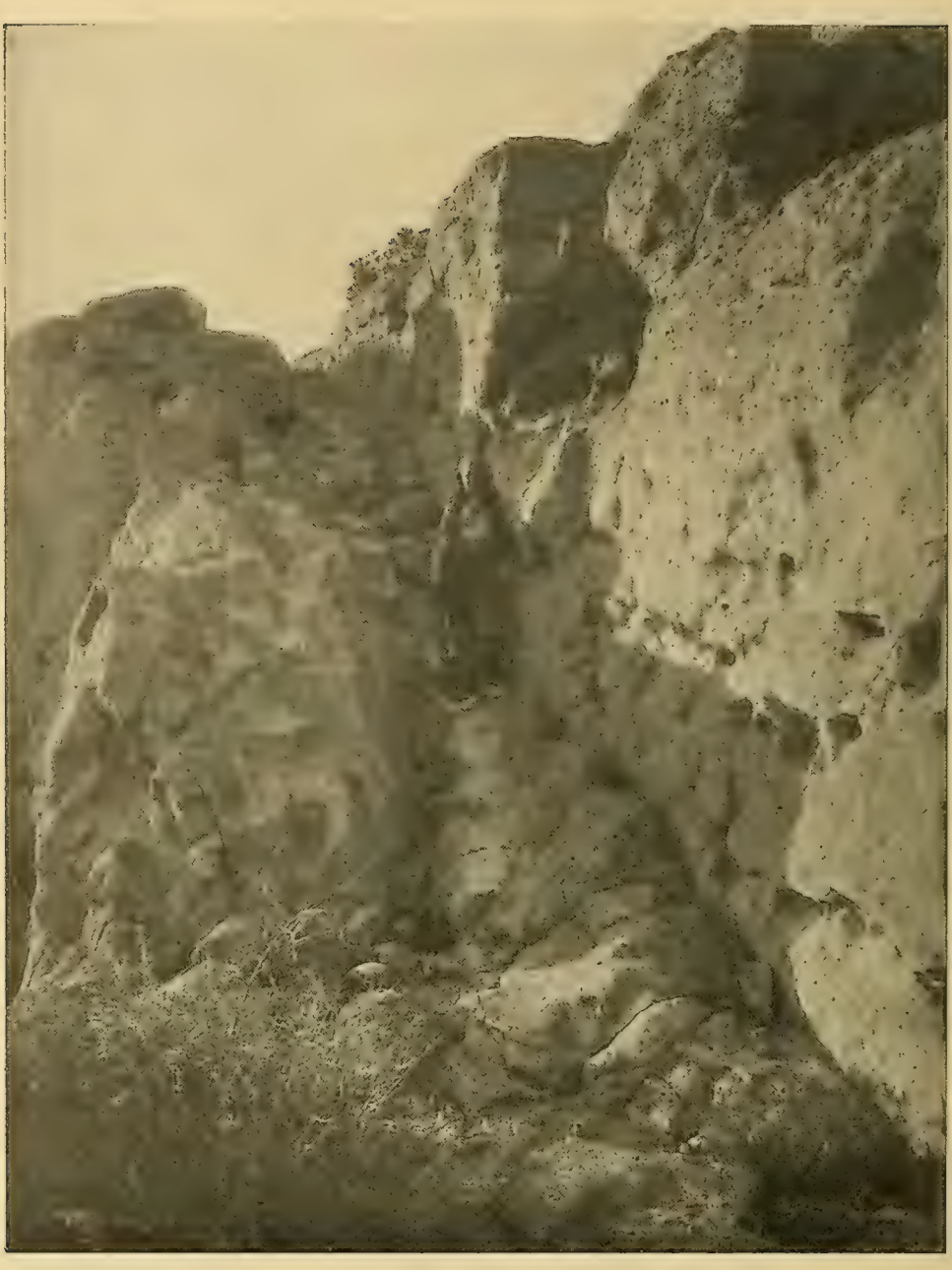
AMONG THE WONDERFUL TENT ROCKS OF OTOWI, A NEIGHBORING TOWN TO TSANKAWI
Some of these cone-shaped formations were hollowed out and used as dwellings by the ancient inhabitants



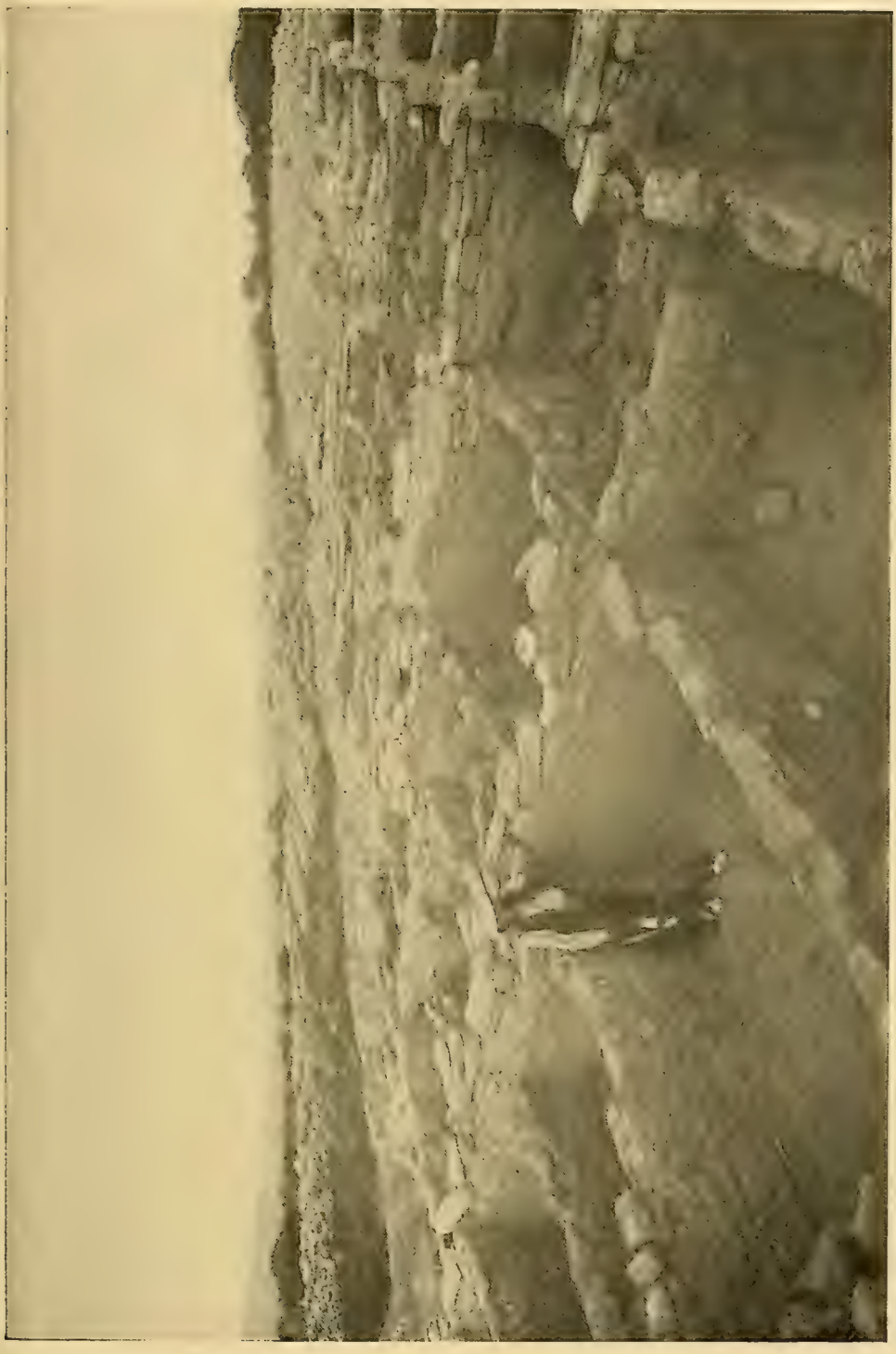
ANOTHER VIEW OF OTOWI, SHOWING SOME OF THE STRANGE TENT ROCKS
The cliff at upper right hand contained many cave dwellings

A FEW OF THE CAVE DWELLINGS AT OTOWI

"AT THE HOME OF HIS FOREFATHERS." SHOWING A SANTA CLARA INDIAN BEFORE THE RUINS OF PUYÉ
The Santa Claras have a tradition that they are descended from these unknown people



PUYÉ: ANCIENT STAIRWAY LEADING TO THE GREAT RUINS ON THE MESA ABOVE
The steps worn by the sandaled feet of the prehistoric inhabitants are clearly shown



RUINS OF PUEBLO ON TOP OF MESA AT PUYÉ, SHOWING A PORTION OF THE EXCAVATION WORK CONDUCTED BY PROFESSOR HEWETT

PUYÉ, SHOWING A FEW OF THE PREHISTORIC CAVE DWELLINGS

They extend along the side of the mesa for more than a mile. The rooms still show plastering. The small holes undoubtedly held the ends of logs used for balconies, etc. A few carvings are shown at top

The regularly hewn stones of which the houses were constructed still lie in great heaps, probably almost as they were left at the time of the exodus, as very little excavation has been done in this particular ruin. Where the debris has been cleared away at all, the walls are found to be standing for only a few feet above the first floor. The arrangement was in the customary quadrilateral form, with court in the center 150 to 200 feet across, and with outlets at two opposite corners of the enclosure.

There were probably 200 rooms on the ground floor; adding two floors above this one (each somewhat smaller than its predecessor) would make a structure of perhaps 400 rooms. Fragments of pottery and arrowheads are easily found in the ruins, particularly in the vicinity of the graves, some of which have been opened in recent years. Undoubtedly a thorough excavation would reveal many skeletons, or mummified bodies, as well as interesting relics in the form of tools, household utensils, etc.

Among the many other prehistoric ruins in this interesting region should be mentioned Tsankawi's nearest neighbors, Navawi and Otowi, as doubtless the ancient inhabitants were constantly passing back and forth between their respective towns, the former being one and one-half miles to the south and the latter two miles to the west, while a few miles farther away is the Pajarito, or Tschirege ("Little Bird"), ruin. There is no doubt that in prehistoric times, throughout this region, which is now almost utterly wild and uninhabited, could be seen a very numerous population industriously engaged in the common occupation, agriculture, in which some skill is evidenced by the finding of the remains or irrigating ditches, reservoirs, etc.

Each of these ruins seems to have its own characteristics. For instance, at Navawi ("Place of the Game Trap") is found a pit cut in the solid rock for the purpose of capturing deer, bear, and the like, it being a bottle-shaped excavation, about six feet long and three feet wide at the top and fifteen feet deep. This is located on the top of the mesa toward one end, and is reached by four well-worn paths.

At the village in Otowi Cañon the wonderful "Tent Rocks" comprise the distinctive feature. In this vicinity there are probably fifty of these cone-shaped, porous formations of tufa, about one-half of them bearing on the pinnacle a stone of another kind. Some of these Tent Rocks were excavated by the ancient people and used as dwelling-places, the interior walls still showing the prehistoric plaster.

Ten miles to the north and reached from Espanola Station is Puyé, another great ruin. Here there is a most excellent stairway from the cave dwellings on the side of the mesa to the ruins above, where important excavations were conducted recently by Prof. Edgar L. Hewett, Director of the Archæological Institute of America. It is estimated that there were upwards of 500 rooms on the ground floor, and about 100 of these, forming one side of the rectangular arrangement, have been excavated, exposing almost intact the walls of the first floor. Much pottery and many *metates* and *manos* (stones for grinding corn) were found, as well as a number of skeletons.

What became of the Cliff Dwellers, and are there any descendants living at the present day? These questions naturally present themselves to every one who becomes at all interested in the subject. Numerous theories have been advanced, but probably the sanest is that put forth by Professor Hewett in his "Antiquities of the Jemez Plateau." His conclusion (based on known facts as well as tribal traditions) is that the Cliff Dwellers of this region abandoned their homes on the mesas from six to eight hundred years ago and moved to the valleys, where they became scattered and eventually lost their identity, the tribes being finally swallowed up in those of the present Pueblo Indians, among whom scientists have been able occasionally to find descendants with the "long head" peculiar to the skeletons found in the Cliff Dwellings.

These few are undoubtedly the only

representatives now living of the tribes who had made such advancement in the industries and had attained to such vast numbers in the great southwest hundreds of years before the arrival of Columbus in the New World. However, the work is to be continued, and it is altogether probable that more extensive excavations and researches will bring to light additional facts hitherto undreamed of. Certain it is that the subject is a most fascinating one, and the great interest recently awakened cannot but be productive of valuable results.

HIDDEN PERILS OF THE DEEP *

By G. R. Putnam, U. S. Coast and Geodetic Survey

NAUTICAL charts are known to have been in use since the thirteenth century A. D., but systematic surveying and chart-making date back little more than a century, and most of the information shown on modern charts has been gathered in that time. Of the total area of the earth's surface nearly three-fourths, or about 145,000,000 square statute miles, is occupied by the oceans.

The charting of this immense area, and particularly of the great lengths of coast line and of the island and reef-strewn portions, is evidently a work of magnitude. To aid in this work is an obligation resting upon all maritime nations, not only for the benefit of their own commerce, but for the common good of the world. At present many of these nations have made or are extending and perfecting the surveys of their own coasts, and a number of them are adding to the general knowledge of the hydrography of the seas.

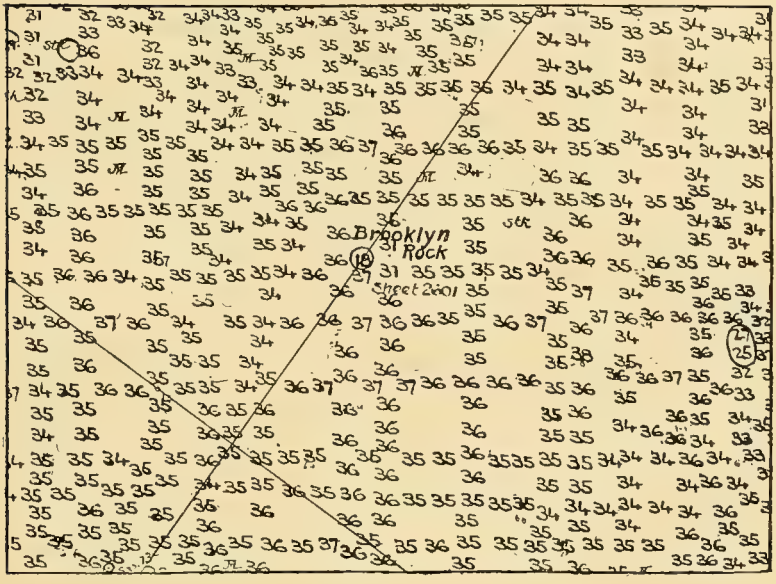
Great Britain especially has done an immense work in improving the charts of many parts of the world. About eighteen nations are publishing nautical charts, and it is estimated that a million copies are issued annually. The British series includes 3,725 different charts, covering practically all oceans and coasts.

Notwithstanding the amount of work done and the number of charts now published, but a comparatively small portion of the continental borders and of the waters of the oceans can be considered as completely surveyed at the present time. Parts of the coasts have been simply sketched by passing vessels, and other areas have been surveyed rapidly to get the information for a preliminary chart. In some cases the original surveys were made to a standard and scale to meet the reasonable requirements of the time, but without counting on the needs of the future, depending on the growth of population, the building of cities, and the changes in the trend of trade.

TREMENDOUS INCREASE IN THE SIZE OF STEAMERS NECESSITATES NEW CHARTS

With the increase of commerce and of the speed of vessels, more direct routes are demanded for reasons of economy. Inside passages not originally used are sometimes developed for defensive reasons. The average draft of the larger vessels has also increased remarkably since the modern hydrographic surveys were commenced, and surveys once made to insure safety for the deepest vessels of that time are no longer adequate. The average loaded draft of the 20 largest steamships of the world has increased as follows: 1848, 19 feet; 1873, 24 feet; 1898, 29 feet; 1903, 32 feet. The average length of these vessels was 230 feet in 1848, 390 feet in 1873, 541 feet in 1898,

* This article is in the main taken from the book "Nautical Charts," by G. R. Putnam, published by John Wiley and Sons, New York, 1908. Most of the illustrative material is from the work of the U. S. Coast and Geodetic Survey; some of the sketches of Haulover Break are from a paper by F. P. Gulliver.



THE BROOKLYN ROCK IN BUZZARDS BAY, MASSACHUSETTS

Hundreds of soundings were made in the vicinity of this small rock, and yet its presence was never discovered until the cruiser *Brooklyn* struck it in 1902. (This diagram is a portion of the original hydrographic sheet).

and 640 feet in 1903. The number of vessels drawing as much as 26¼ feet rose from 36 in 1902 to 185 in 1904. In 1906 there were 17 vessels afloat drawing 32 feet and upward. There are now two steamers on the Atlantic 790 feet long, 88 feet beam, and 37½ feet draft when fully loaded, and two vessels with a length of about 860 feet are under construction.

THE ROCK ON WHICH THE BROOKLYN STRUCK

Good and reliable charts can be made only from correct surveys. It is said that men are apt to believe anything they see on a map. As to the nautical chart, the mariner is apt to be somewhat more critical, however, and it is well that he is. There is great difficulty in charting thoroughly an invisible surface, such as the bottom of the sea, and but a small part of the navigable waters is surveyed in sufficient detail to be certain of the absence of dangers.

It is obvious that the plan of mapping the sea bottom by dropping a lead at intervals over its hidden surface is far from an ideal one. The lead gives the depth only at the point at which it touches the bottom, and no information as to the space between the casts except such as may be inferred from the relation of successive soundings. In numerous cases, after what was considered a thorough survey of a region had been made, at some later day a pinnacle rock or other danger has been discovered. For instance, a detailed hydrographic survey of Buzzards Bay was made in 1895; the sounding lines were run at intervals of 50 to 100 yards, and 91,000 soundings were made for a single sheet. Within this area the cruiser *Brooklyn* in 1902 struck a rock which was found to have 18 feet over it. (See diagram.) The least depth in the vicinity developed in the original survey was 31 feet.

In 1902 a rock with 27 feet over it, surrounded by depths of 50 feet, was located in the North River, New York Harbor, lying about 400 yards off the Battery, in a position such that vessels

must have been passing over it for many years. Notwithstanding close surveys of the vicinity, it had escaped detection until with increasing draft vessels began to touch it. The steamer *Pilgrim* was damaged in 1884 by striking a rock in the East River lying 350 yards off shore. This rock had but 13 feet over it, surrounded by depths of 30 feet; it was sharp and of small extent and was not found in the first surveys.

SWEEPING THE BOTTOM OF THE SEA

Dragging for dangers has long been resorted to for the investigation of isolated spots. A valuable and successful means has been employed recently of making sure that an area is free from shoals or rocks having less than a certain depth. This is done by dragging through the water a wire from 500 to 1,400 feet long and suspended at the required depth with suitable buoys and weights and kept taut by the angle of pull. If, for instance, the wire is set at a depth of 30 feet, it will indicate the presence of any obstruction of less depth by catching on it and upsetting the buoys, and such spots are at once marked and investigated. Considerable work has been done with such drags in the last few years on the Great Lakes and on the Atlantic and Gulf coasts of the United States.

This is of course a somewhat tedious process and gives no information as to depths greater than that for which the wire is set, but the experience already had indicates its great value. It will probably be found desirable in time thus to drag all water areas important to navigation where the depth is near the draft of vessels and the irregular nature of the bottom gives indication of dangers. In extensive dragging operations near Key West and in Jericho Bay, Maine, a number of shoals have been picked up which were not found in the original surveys.

A remarkable instance of the value of the drag was the recent discovery of a rock in Blue Hill Bay, on the coast of Maine. This rock has but 7 feet of water over it and is only 6 feet in diameter at the top. It is surrounded by depths of 78 feet, and has a small base from which it rises abruptly. The original survey gave no indication of a danger here, and its existence was not suspected until it was discovered by the wire drag catching on it.

ROCKAWAY BEACH, N. Y., GROWS AT THE RATE OF 8 INCHES A DAY

The making of the survey and the printing of the chart do not complete the problem of the chart-maker. Both nature and man are constantly changing the facts represented on the charts. Breakwaters and jetties are built, and channels and harbors are dredged, and cities and towns grow up.

A comparison of an early chart of New York Harbor, made in 1737, with the present conditions illustrates well the effect of the growth of a community and port on the problem of chart construction. (See page 825.)

Another interesting example is afforded by Galveston Harbor. (See page 826.) Before the adoption, in 1874, of the project for jetties at Galveston Entrance, there was a natural depth of 12 feet on the outer bar; the effect of the jetties and of dredging has been to give a channel depth of about 28 feet.

Great natural agencies are also constantly at work effecting changes in features shown on the charts. The action of currents and waves is continually cutting away or building the shore, particularly on sandy coasts exposed to storms. When surveyed in 1849, Fishing Point on the east coast of Maryland, was but a bend in the shore line. By 1887 it had built out about two miles in a southerly direction, and in 1908 about one mile farther, curving to the westward. Altogether in 60 years this tongue of land has grown out over three miles. (See page 828.)

Between the surveys of 1835 and 1908 Rockaway Beach, near New York, has grown to the westward 3.3 statute miles, pushing Rockaway Inlet before it. (See page 830.) This is at an average rate of 238 feet each year, or nearly 8 inches

CHART OF NEW YORK HARBOR MADE IN 1737

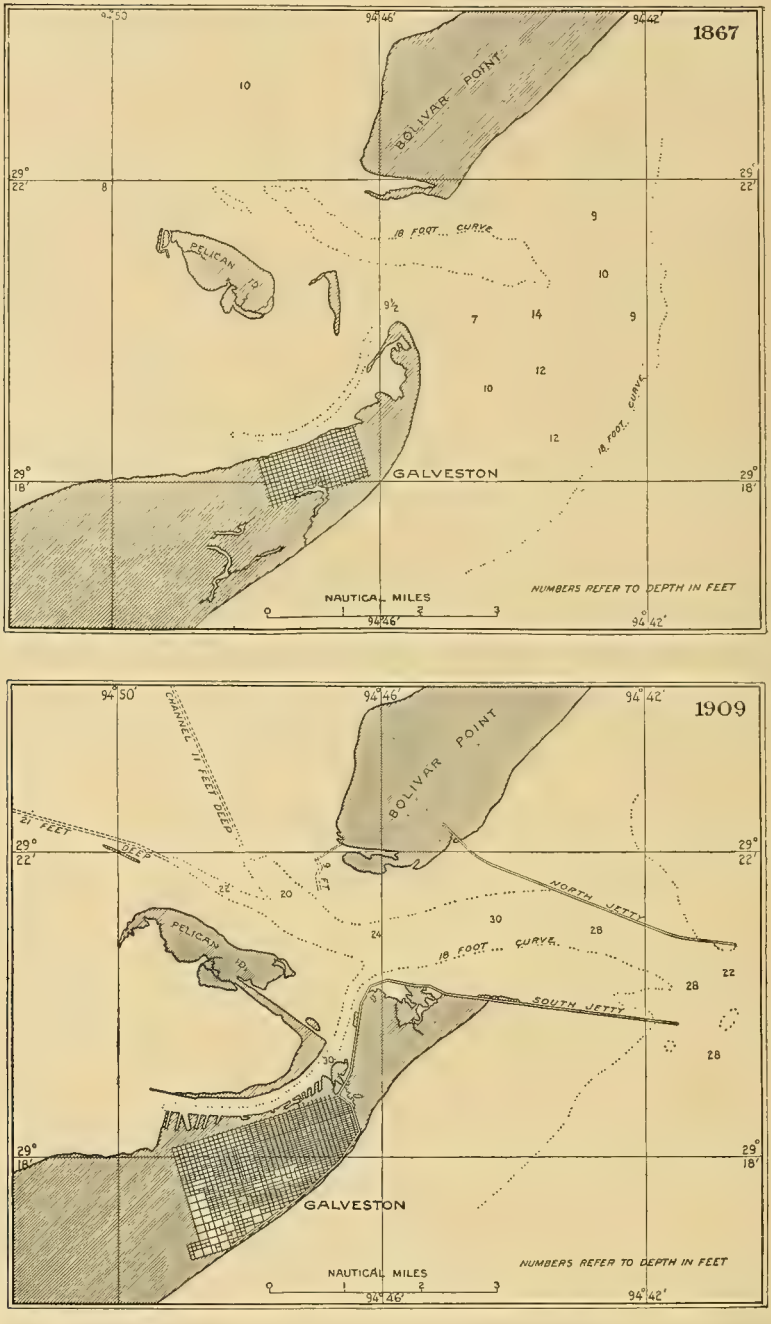
each day. During the same period of 73 years the western end of Coney Island has moved westward less than 0.2 mile.

The Haulover is a narrow strip of land on the eastern side of Nantucket Island, separating Nantucket Harbor from the ocean. This was broken through by the sea in 1896, and after remaining open for 12 years, closed again in 1908 through natural causes. (See page 831.)

Much of the change observed along coasts composed of the softer materials is the cumulative effect of wave and storm action. In some exposed localities channels through shifting materials change rapidly and frequently; so that, no matter how accurate the survey, the chart cannot be depended upon to represent the true conditions for more than a short time. At Fire Island Inlet, Long Island, it is reported that the local boatmen must take soundings two or three times a week for about nine months of the year, and especially after every blow, in order to keep track of the best channel. On the other hand, the great storm at Galveston on September 8, 1900, did not materially affect the available channel depth of 26 feet into that harbor, although the severity of the storm was such as to raise the tide 15 feet above normal, to largely destroy the city, and to cause long breaks in the jetties. This storm cut back the beach 400 to 600 feet in some places and slightly built it out in others, but on the whole had little effect on the charted information.

FIFTY SQUARE MILES OF NEW LAND MADE IN 50 YEARS

Rivers are bearing vast quantities of sediment and depositing these near their



EFFECT OF IMPROVEMENTS AT THE ENTRANCE TO GALVESTON, TEXAS, FROM THE CHARTS OF 1867 AND 1909 (SEE PAGE 824)

mouths, pushing out the cost line and filling in the bottom. The main mouths of the Mississippi are advancing into the Gulf, but at a comparatively slow rate. A break from the main river at Cubits Gap, just above the head of the passes, however, has done an enormous amount of land-making, filling in an area of about 50 square miles between 1852 and 1905. (See page 833.)

The mouth of the Columbia River is an interesting example of remarkable changes of channel and of the movement of an island. Vancouver in 1792 found but one broad channel and no island. The chart of 1851 shows two channels separated by Sand Island, the northern channel being the deeper. In 1851 the center of this island was 3¼ miles southeast of Cape Disappointment, in 1870 it was 2¾ miles southeast, and in 1905 it was 1¼ miles easterly. Since 1851 this island has thus moved 2 miles northwesterly directly across the middle of the river entrance, closing up the northern channel and leaving the river with a single channel, as in Vancouver's time. (See page 834.)

REMARKABLE CHANGES CAUSED BY VOLCANOES AND EARTHQUAKES

Volcanic action in well authenticated cases has caused islands to rise or disappear. In the present location of Bogoslof Island, in Bering Sea, the early voyagers described a "sail rock." In this position in 1796 there arose a high island. In 1883 another island appeared near it. In 1906 a high cone arose between the two, and a continuous island was formed about 2 miles long and 500 feet high. In 1907 this central peak disappeared, and in its place there is at present a bay with from 4 to 25 fathoms of water. Bogoslof is an active volcano, and the main changes have been the result of volcanic action. The history of this island for over a century past forms a remarkable record of violent transformations.

Earthquakes sometimes cause sudden displacements, horizontal or vertical, of sufficient amount to affect the information shown on the charts. A careful investigation of the effects of the earthquake in Yakutat Bay, Alaska, in September, 1899, showed that the shore was raised in some parts with a maximum uplift of 47 feet and depressed in other parts, and that at least two reefs and four islets were raised in the water area where none appeared before. Undoubtedly there were changes in the water depths, but definite information is lacking because there had been no previous hydrographic survey.

The San Francisco earthquake of 1906 caused little vertical displacement, but there were horizontal changes of relative position as much as 16 feet; so far as known, this earthquake did not affect the practical accuracy of the charts. The Italian government recently announced that the terrible Messina earthquake of 1908 has had no effect on the navigability of the Straits of Messina.

Related to earthquake phenomena are the gradual coast movements of elevation or subsidence which are taking place, but at so slow a rate as not to sensibly affect the charts in ordinary intervals of time.

Another agency at work is the coral polyp on the coral reefs; although the rate of growth appears to be very slow, the resulting reefs and keys are an important feature in tropical seas.

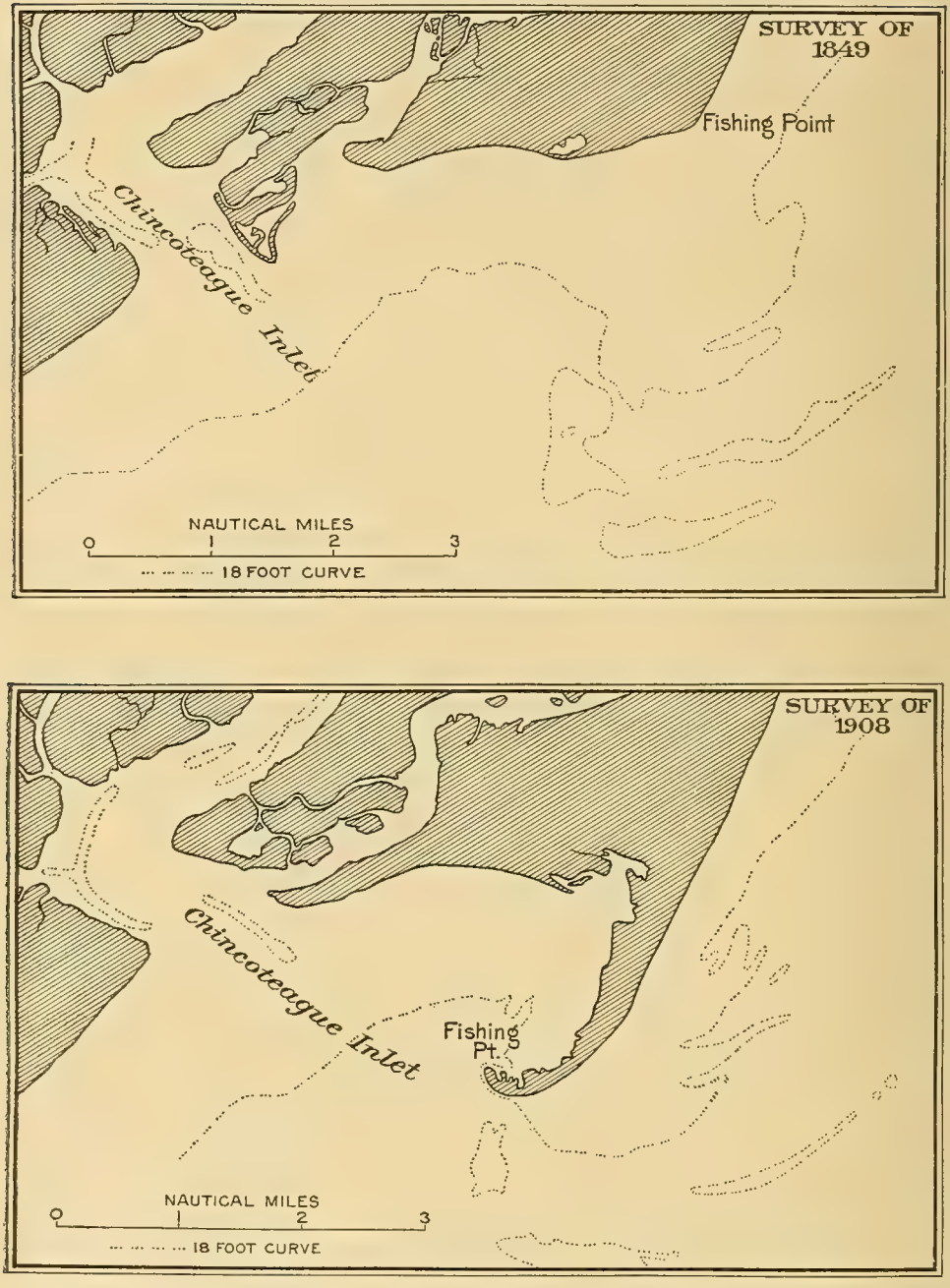
Changes in apparent shore line as shown on the charts are also caused by movements in the fronts of glaciers discharging into the sea. An instance of this is the recession of Muir Glacier in Alaska. As a result Muir Inlet in 1907 extends 7½ miles farther north than in 1895, and a mountain of 1,020 feet elevation on its eastern shore has been uncovered by the departure of the ice.

Practically all the land features shown on charts are likewise subject to changes, the more rapid of which are mainly due to the works of man.

The changes of channels and of commercial needs cause many alterations to be made from time to time in the lights and buoys which are shown on the charts.

KEEPING OUR CHARTS UP TO DATE

The problem of keeping a chart sufficiently up to date is one of much practical importance and one which must be



FISHING POINT, MARYLAND, FROM SURVEYS OF 1849 AND 1908, ILLUSTRATING BUILDING OUT OF A POINT ON THE COAST (SEE PAGE 824)

taken into account in planning what should be shown on the chart in the first place so as to bring it within the range of practicable revision.

Certain features are corrected at once on the charts as soon as the information is received, such as dangers reported and changes in lights and buoys. Where harbor works are in progress the periodic surveys made by the engineers in charge furnish data which are applied promptly to the charts. Reported dangers in channels and bars are investigated by special surveys and the information is put on the charts. Examinations are made from time to time for the revision of the features along the coast line. Complete resurveys have been made, at long intervals, of some important portions of the coast where there has been evidence of change, and these, when they become available, are applied to the charts. All parts of the coast where the exposed portions are not of very permanent material will require resurveys at intervals, depending on their importance and the rate of change.

Notwithstanding the great progress made in hydrographic surveys, a considerable number of rocks and shoals dangerous to navigation and not previously shown on the charts are reported, averaging nearly 400 each year for the last six years, according to the British reports. Of the 367 reported in 1906, 11 were discovered by vessels striking them.

DOUBTFUL OBJECTS ON CHARTS

In addition to the problem of perfecting the charts as respects omissions in earlier surveys and correcting them to show changes which have actually taken place, there is an important task of improvement necessitated by the investigation of doubtful objects which have gotten on the charts and which may have no existence. The uncertainties in many of the earlier positions may be judged by the fact that as late as 1713 the British "commissioners for the discovery of longitude at sea" offered a reward of ten thousand pounds for the discovery of a method of determining the longitude *within 60 miles.* Compensated timepieces, which have been so important a factor in improving navigation, were not invented until about 1761.

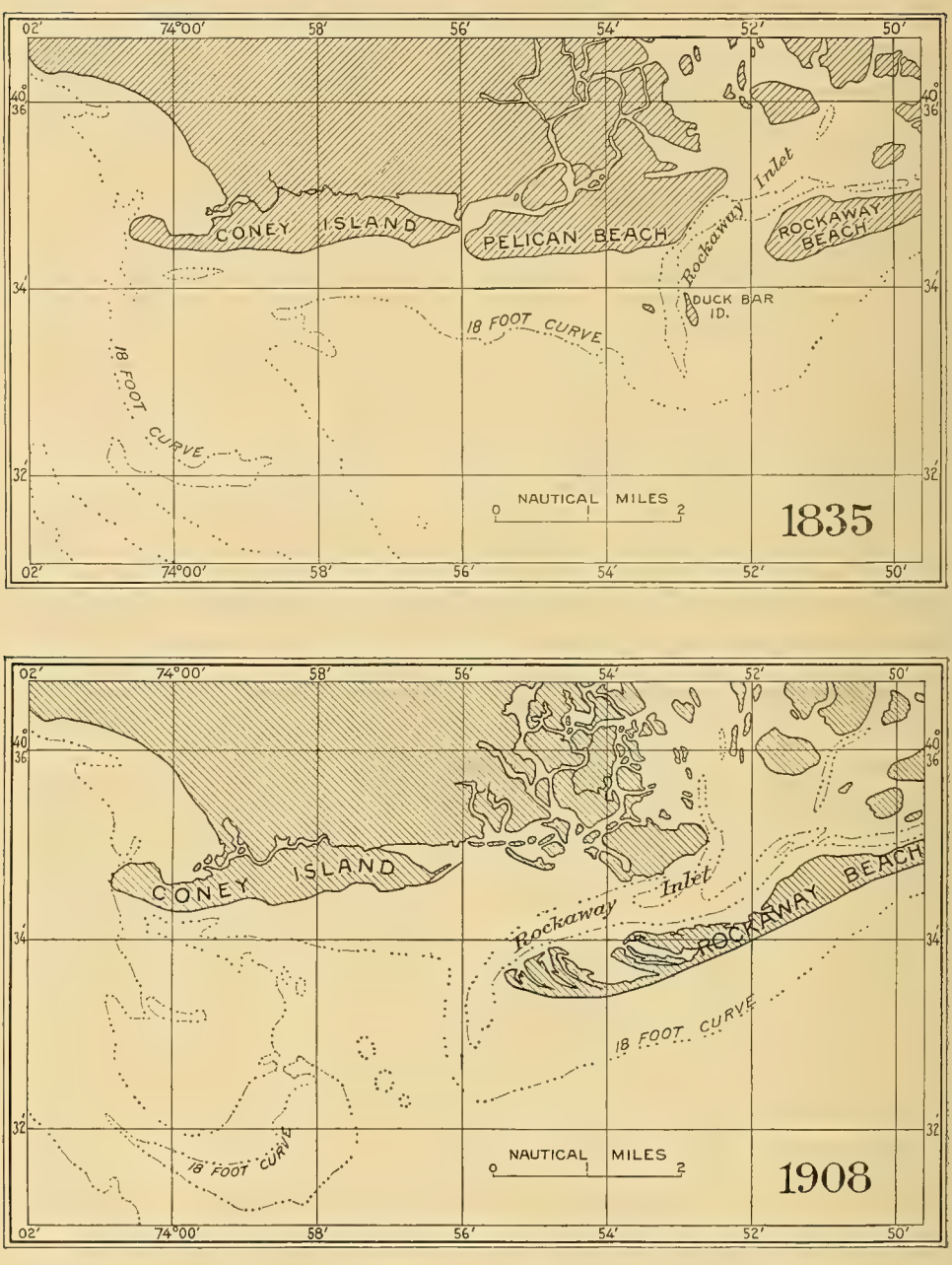
On the earlier charts and on those of more remote regions at the present day much work has been sketched rather than surveyed. Even in the better surveyed portions reports come in as to dangers or other matters not shown, and if of importance and the report appears to be reliable, these are sometimes at once put on the chart pending further investigation, or in other cases an examination is first made.

Shoals, rocks, and even islands have in numerous instances been put on the charts from the reports of passing vessels, without systematic surveys. Many of these no one has been able to find again, and after repeated searches some of them have been removed. The same island or danger has sometimes been charted in two or more different positions as reported at various times. The treatment of such cases is one of the serious and interesting problems of the chart-maker. It is generally less harmful to show a danger which does not exist than to omit one which does exist. On the other hand, a non-existing danger shown on a chart may be the cause of actual expense and loss of time in compelling a vessel needlessly to go out of its course.

It is surprising to note with what lack of care and of sufficient evidence reports of dangers at sea have sometimes been made, and how incomplete are many of the reports even when the existence of the danger is beyond question. It is unfortunately true that some of these reports are the result of effort to escape blame for accident by throwing the fault on the chart. Many such reports also result from various illusory appearances.

HOW FALSE REPORTS ARE STARTED

A large tree covered with weeds, an overturned iceberg strewn with earth and stones, a floating ice-pan covered with earth, the swollen carcass of a dead whale, a whale with clinging barnacles



MOVEMENT OF ROCKAWAY BEACH AND INLET, LONG ISLAND, FROM 1835 TO 1908
(SEE PAGE 824)

CHANGES IN SHORE OF NANTUCKET ISLAND, MASSACHUSETTS, FROM 1890 TO 1908, SHOWING OPENING AND CLOSING OF THE BREAK THROUGH THE HAULOVER (SEE PAGE 825)

and seaweed, reflections from the clouds, marine animalculæ, vegetable growth, scum, floating volcanic matter, and partially submerged wrecks covered with barnacles have been mistaken for islands, shoals, or reefs.

A school of jumping fish has given the appearance of breakers or caused a sound like surf, and tide rips have often been mistaken for breakers. Raper very properly calls attention to the obligation resting upon every seaman to investigate carefully doubtful cases and to make reliable reports. "Of the dangers to which navigation is exposed none is more formidable than a reef or a shoal in the open sea; not only from the almost certain fate of the ship and her crew that have the misfortune to strike upon it, but also from the anxiety with which the navigation of all vessels, within even a long distance, must be conducted, on account of the uncertainty to which their own reckonings are ever open. No commander of a vessel, therefore, who might meet unexpectedly with any such danger could be excused, except by urgent circumstances, from taking the necessary steps both for ascertaining its true position and for giving a description as complete as a prudent regard to his own safety allowed."

As to the older doubtful dangers now shown on the oceanic charts, it is estimated that the positions may be considered as uncertain by 10 miles in latitude and 30 miles in longitude, and areas of this extent must be searched to determine definitely the question of their existence.

WRECKS THAT CAUSED TROUBLE

The following are interesting or typical cases of reported dangers:

The Spanish steamer *Carmen* was wrecked in 1891 by running on a rock off the southwest coast of Leyte, in the Philippines; the rock was reported to lie one mile off shore, a dangerous position for vessels using Canigao Channel. A survey made in 1903 showed 58 feet of water in this location, and that Carmen Rock, on which the vessel struck, was really within one-fourth mile of the beach. The rock had, however, for twelve years been shown on the charts in a position which made it an obstruction to navigation.

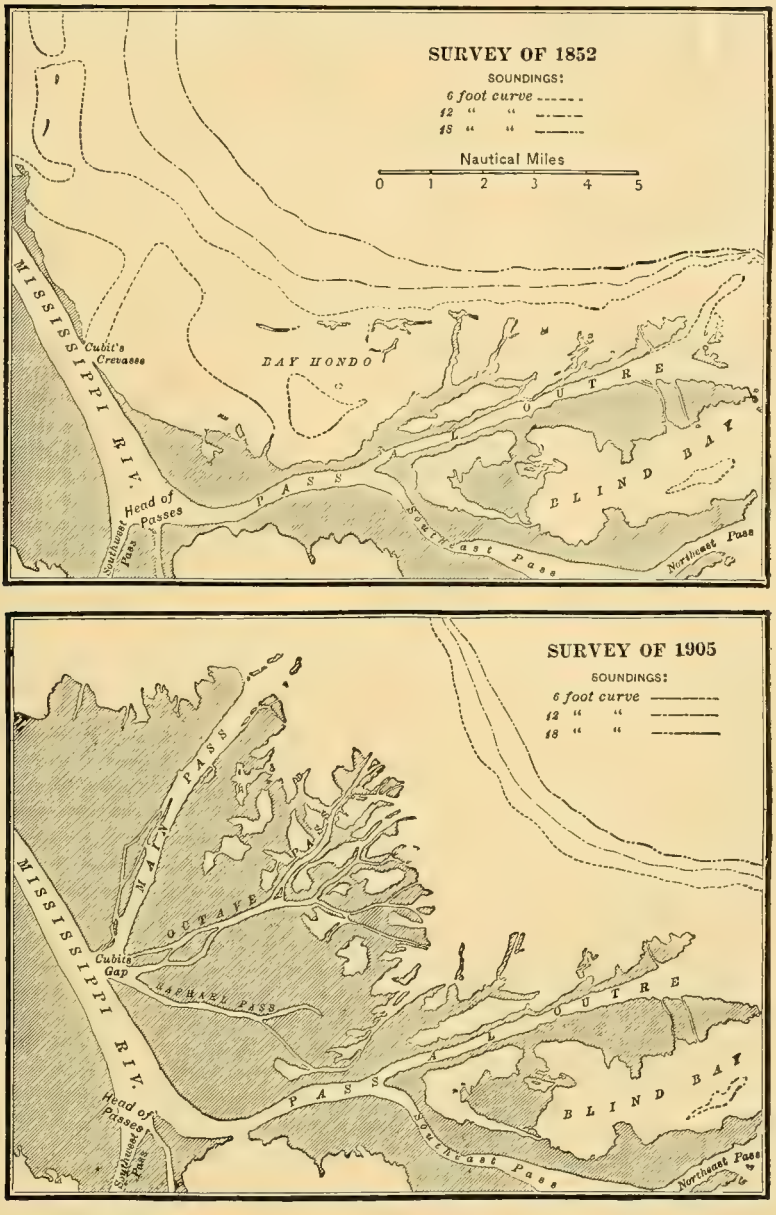
The ship *Minerva* in 1834 was reported to have struck a rock near the middle of the broad entrance to Balayan Bay; the fact that this occurred at 2 a.m. indicated a very doubtful position, but it was stated that an American ship had previously been wrecked on the same rock. It consequently appeared as a danger on the charts for seventy-one years, when a survey showed no depth of less than 190 fathoms in this vicinity, and it was removed from the charts.

A British steamer was wrecked in San Bernardino Strait in 1905. The master reported that he was in a position where the chart showed 51 fathoms, and that he was 1½ miles distant from Calantas Rock, and on these grounds the finding of the official inquiry was that "no blame can be attached to the master, officers, or any of the crew for the casualty." Very shortly after the disaster the surveying steamer *Pathfinder* definitely located the wreck and made a survey of the vicinity. The previous chart of Calantas Reef was found to be fairly correct, and the stranding was determined to have occurred well within this reef, in a position where the chart showed soundings of 3¾ to 4¾ fathoms, and one-half mile from Calantas Rock, which rises 5 feet above high water.

A transport entering San Bernardino Strait a few years ago ran on a rock and was damaged. The position was reported as about two miles southeast of San Bernardino Island and near the middle of the passage. The rock was not put on the charts, as prompt investigation showed 50 fathoms of water in this vicinity, and that in all probability the transport actually touched a small reef making out from the island.

The master of the brig *Helen* reported that his vessel was wrecked on a reef lying six miles from Rockall. When surveyed Helen Reef was found to be about one-third this distance from Rockall.

An island has been reported in eight



GROWTH OF LAND AT CUBITS GAP, MISSISSIPPI DELTA, FROM 1852 TO 1905 (SEE PAGE 827)

COLUMBIA RIVER ENTRANCE, SHOWING MOVEMENT OF SAND ISLAND, AND CHANGES FROM 1792 TO 1905 (SEE PAGE 827)

different positions, ranging in latitude from 30° 29′ to 30° 42′ N. and in longitude from 139° 37′ to 140° 38′ E.

DOUBTFUL ISLANDS

There have been a number of reports of islands in the area from latitude 40° 00′ to 40° 30′ N. and longitude 150° 30′ to 151° 00′ W. The master of the bark *Washington* reported in 1867: "On my passage from the Sandwich Islands to the northwest coast of the United States, when in latitude 40° 00′ N., in a dense fog, I perceived the sea to be discolored. Soundings at first gave great depths, but diminished gradually to 9 fathoms, when through the mist an island was seen, along which I sailed 40 miles. It was covered with birds, and the sea swarmed with seal and sea-elephants." A United States vessel searched in this vicinity without seeing any indication of land, and obtained soundings of 2,600 fathoms. A British ship in 1858 searched for fourteen days over this area without finding anything. Searches were also made in 1860 and 1867 without success, and the present charts show no islands in this part of the Pacific.

In a number of cases erroneous positions have been due simply to blunders. Thus Lots Wife, first seen by Captain Meares in 1788, was shown on his chart in latitude 29° 50′ N., longitude 156° 00′ E., and stated in his book to be in latitude 29° 50′ N. and longitude 142° 23′ E. Massachusetts Island by one report was in longitude 177° 05′ E. and by another in 167° 05′ E. The apparent blunder of 10° is now immaterial, as the island has disappeared from the charts altogether. The Knox Islands were placed by the Wilkes Exploring Expedition in latitude 5° 59′ 15″ N., longitude 172° 02′ 33″ E. The old charts showed islands of this name also in latitude 5° 59′ N., longitude 172° 03′ W., the longitude being doubtless transposed. In the case of Starbuck Island, discovered south of the Equator, the latitude was apparently transposed, as on old charts it was also shown in the position, latitude 5° 40′ N., longitude 156° 55′ W.

A pinnacle rock can sometimes be located only with great difficulty, even when known to exist. Rodger Rock, on which the bark *Ellen* struck and was damaged, lies in latitude 0° 41′ 15″ N. and longitude 107° 31′ E. It has but three feet over it at low tide. The British surveying ship *Rifleman* searched four days before finding it, although the plotted tracks showed that she and her boats had passed very close to it. This indicates that great caution must be used in removing a reported danger from the charts.

A comparison of a Pacific Ocean chart of about forty years ago with one of the present time (see page 836) illustrates in a striking manner how many doubtful dangers, or vigias, have gotten on the charts and how after laborious search many of them have now been removed. This condition was especially true of the Pacific, owing to the numerous reports of an indefinite nature from whaling ships, among whose captains there was a saying "that they do not care where their ship is, so long as there are plenty of whales in sight."

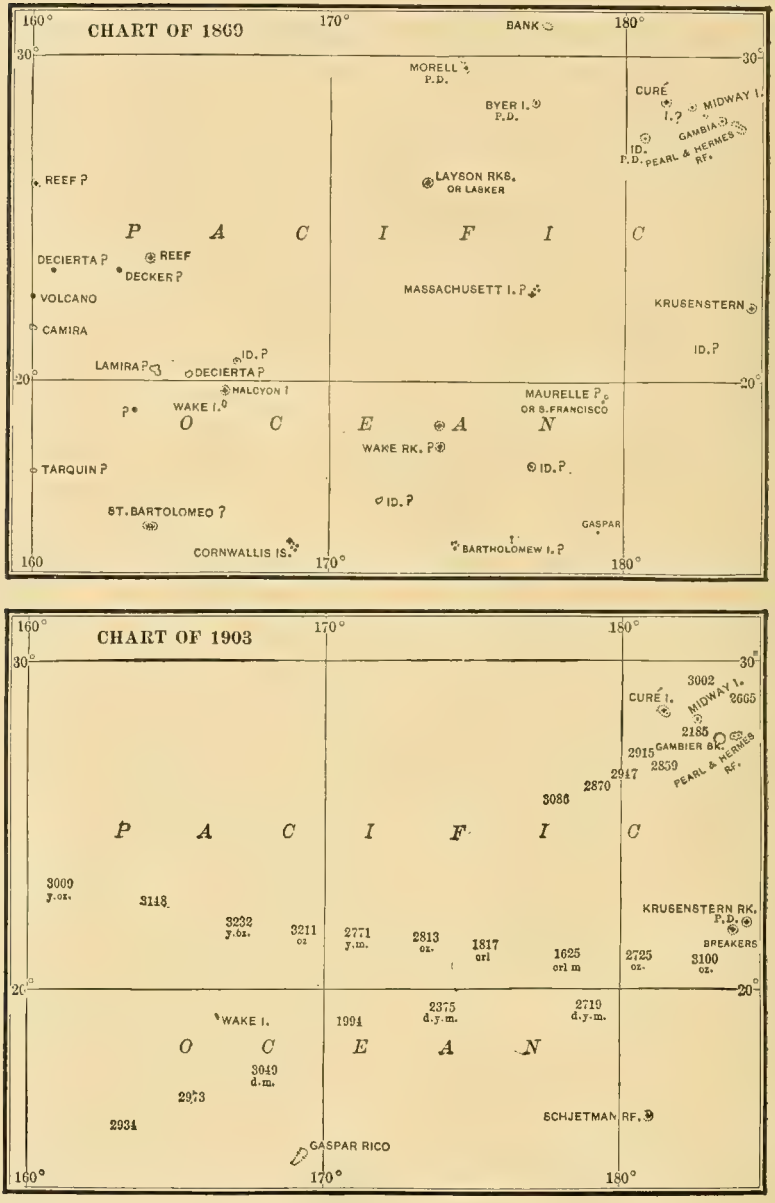
DEATH TRAPS THAT MIGHT HAVE BEEN AVOIDED

That the use of corrected and up-to-date charts is important is illustrated by the following instances, taken from the records of the British courts, showing the results of failure to provide such charts:

In 1890 the steamer *Dunluce* was lost owing to the use of an old edition of the Admiralty chart which showed a depth of 4½ fathoms on the Wikesgrund, whereas the later charts showed much less water.

In 1891 the steamer *Trent* was lost on the Missipezza Rock, in the Adriatic. The ship was navigated by a private chart, published in 1890, which did not show this rock, and by sailing directions published in 1866.

The steamer *Aboraca,* stranded in the Gulf of Bothnia in 1894, was being navigated by a chart corrected to 1881, which



PORTION OF CHARTS OF 1869 AND 1903, OF THE PACIFIC OCEAN WEST OF THE HAWAIIAN ISLANDS, TO ILLUSTRATE THE REMOVAL OF DOUBTFUL DANGERS

did not show that the Storkallagrund light vessel had been moved eight miles.

The steamer *Ravenspur* was lost on Bilbao Breakwater owing to the use of a chart not up to date, which did not show the breakwater. In 1898 the steamer *Cromarty* was lost in attempting to enter Ponta Delgada Harbor, and in 1901 the steamer *Dinnington* was lost by steaming on to the new breakwater in Portland Harbor; both of these disasters were likewise due to the use of old charts which did not show the breakwaters.

The records of the courts of inquiry also show cases where vessels have been wrecked owing to the use of charts of too small scale.

In 1890 the steamer *Lady Ailsa* was lost on the Plateau du Four. The only chart on board for this locality was a general chart of the Bay of Biscay, and the stranding was due to the master's mistaking one buoy for another. The court found that the chart, although a proper one for general use, was not sufficient for the navigation of a vessel in such narrow waters and on such a dangerous coast.

THE WHEELER NATIONAL MONUMENT

ONE of the late additions to our great system of national parks is the Wheeler National Monument, located in the Rio Grande National Forest, Colorado. The tract included by the President in his proclamation of December 8, 1908, about 300 acres in all, is situated on the south slope and near the summit of the Continental Divide, at an approximate elevation of 11,500 feet. The monument is named in honor of Captain George Montague Wheeler, of the U. S. Engineers, the leader of many surveying and exploring parties of the early 70's, who did much to blaze a way for settlement in that part of the West.

The principal value of the land as a national monument lies in the fact that the fantastic forms resulting from the rapid erosion of rock and soil make the spot one of exceptional beauty. The numerous winding canyons, broken ridges, pinnacles, and buttes form such striking and varied scenes that it will be much visited by tourists when its location becomes more widely known. As a matter of fact it rivals the wondrous Garden of the Gods, about which so much has been written, and is nearly as extensive in area. The towering rock formations, varying in color from a brilliant terra cotta to bright yellow and white, lifting against the wonderful blue of the matchless Colorado sky, and the splendid atmospheric conditions enabling one to see clearly for miles and making objects stand out in striking relief, all count in the sum total of scenic beauty. These lava formations are so strange and fantastic that it does not take a great stretch of imagination to picture the country as the playground of the giants of some prehistoric race.

Historical interest also attaches to the region, as it is believed that the ill-fated expedition of John C. Fremont was overtaken by disaster in this immediate vicinity and was forced to turn back. Skeletons of mules, bits of harness, and camp equipage found near this spot give credence to the belief.

Due to the fact that the reservation is considerably off the beaten track, it is necessary to travel some distance after leaving the Rio Grande Railroad at Wagon Wheel Gap. From that point horses and guides can be readily secured to transport the visitor over the intervening stretch of twenty miles to the reservation, and a more delightful outing could not be had than a few days' camping in this beautiful spot.

PANORAMA IN THE WHEELER NATIONAL PARK

The picture can only give a suggestion of the wonders of this spot

IN THE FANTASTIC AND MULTICOLORED LAVA FORMATION NATURE HAS GIVEN THE WHEELER NATIONAL MONUMENT A STRIKING AND BEAUTIFUL STAGE SETTING

VIEWS OF THE STEEP SLOPES: WHEELER NATIONAL PARK

THE NATIONAL GEOGRAPHIC MAGAZINE

NOTES ON BURMA*

By Thomas Barbour

With Photographs by the Author

FEW parts of the wide empire of Britain offer such a tempting array of features which are attractive alike to the ordinary globe-trotter, to the naturalist, the anthropologist, or the hunter of big game as does Burma. The facts and impressions which are recorded here will more than justify this most inadequate sketch if they serve to bring the province farther within the ken of members of the National Geographic Society.

The globe-trotter coming from India cannot fail to be enchanted by the people, as cheery and cleanly as the peasant Hindu is dirty, dull, and sullen. The change in the very atmosphere is more than evident when first one visits the Schway Dagon. The naturalist finds in the mingling of the Indian with the Malayan fauna a bewildering number of birds, reptiles, or insects which will enrich the cabinets of any museum and provide the thrills which only the finding of a long-sought-for novelty can give. I shall have something more to say of the peoples of Burma, and the photographs show some of the more important racial types. Being rather more bored than otherwise by the average tales of big-game hunting, I will merely say that tiger, tsine, sambar, and other deer, as well as most excellent snipe shooting, offer real attraction for those whose interests lie in this line of sport.

Most of the rich province of Burma, now an integral part of India as far as its administration goes, lies to the east of the Bay of Bengal. It extends over about 17 parallels of latitude and has an area of some 236,738 square miles. The population is about 11,000,000. Rich in minerals, it supplies the world with rubies from the famous Mogok mines, where sapphires also occur. There are extensive oil fields at Yenangyoung, on the Irrawaddy below Mandalay. The soil is more than lavish in its yield and the crops of no land are more grateful to the eye than those of Burma.

The chief wealth of the land lies in the enormous forests of teak, now ably administered by the service which has made for itself such an enviable reputation in India. At the lumber yards near Rangoon all visitors are astonished at the sagacity of the trained elephants which work piling the heavy teak logs or pushing them into position for the saws. Away in the upper sections of the province the ele-

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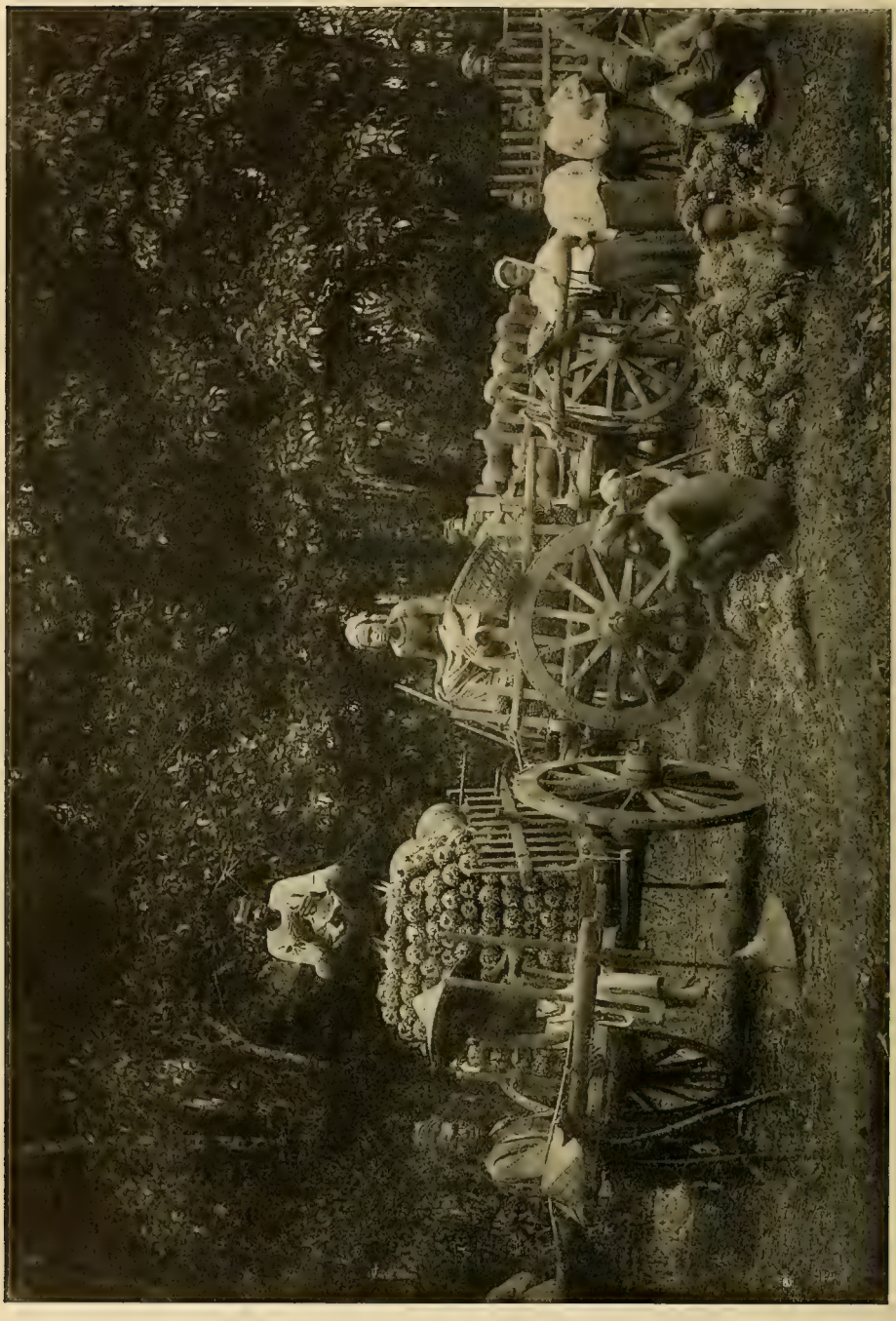
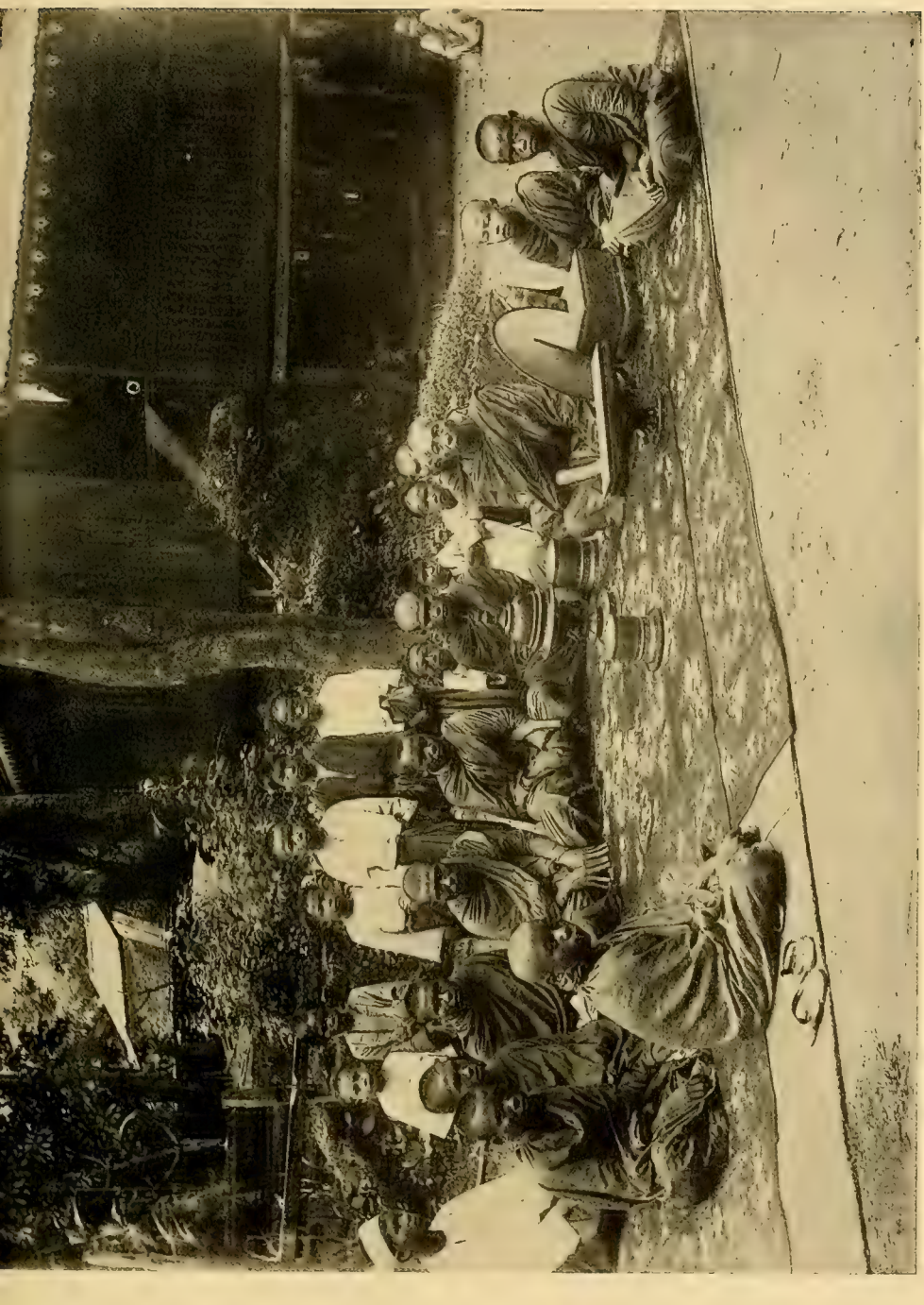
TWO SHAN WOMEN CARRYING A BASKET OF FRUIT: BURMA

This and the succeeding three illustrations are from photographs by Rev. B. M. Jones. All the other pictures accompanying this article are from photographs by [illegible]

A BURMESE WOMAN



GATHERING PINEAPPLES AND JAKFRUIT IN RANGOON: BURMA



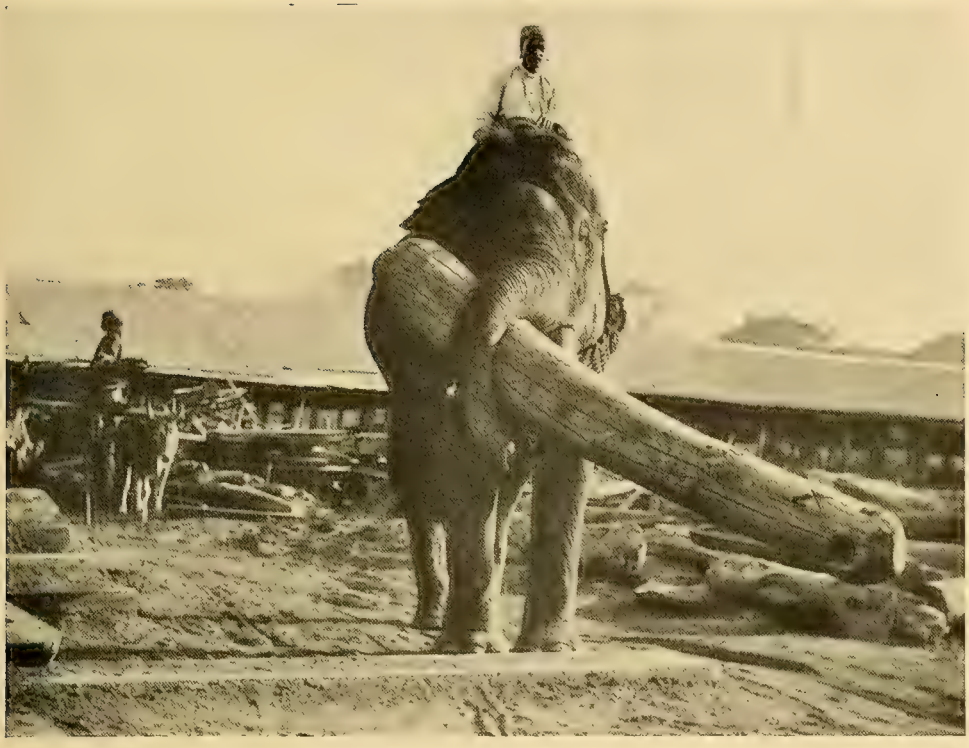
YOUNG BURMESE MONKS, THEIR BOY ATTENDANTS STANDING IN THE REAR

THE GOLDEN SPIRE OF SCHWAY DAGON AT RANGOON (SEE PAGE 852)

MONASTERIES, REST HOUSES FOR PILGRIMS, AND CHAPELS ON THE PLATFORM ON WHICH STANDS SCHWAY DAGON

SHRINES ABOUT THE BASE OF SCHWAY DAGON'S SPIRE

SOME CHAPELS ARE ALWAYS COVERED WITH PALMLEAF MATS WHILE THEY ARE BEING REPAIRED OR REGILDED



ELEPHANT PILING TEAK

phants may be seen carrying supplies to the camps, bringing the logs to water, and carrying the Europeans about who supervise the cutting of the teak. During the last few years, unfortunately, an epidemic of anthrax, or splenic fever, has more than decimated the ranks of domesticated elephants, while the catching of wild elephants is about given up. Let us hope temporarily.

The best months to visit Burma are really December, January, and February. The rainfall is far heavier than over most of northern India, and for this reason the heat of the seacoast is rather oppressive. Inland the rainfall is less and the climate always better. During the rains Burma, like the rest of the tropics the world over, is no place for the person who is solely on pleasure bent. Often in the lowlands near the coast malaria is prevalent, but the whole land is safe for as much as the average person sees of it; more so, indeed, than very many tropic regions.

Nearly every one lands at Rangoon, but it is not the town to give the new arrival a feeling of joy at reaching Burma. Why more do not stay on the same steamer and go somewhere else is not easily explained, except perhaps that Rangoon ends the route for most of the steamers that go there. The arrival at an unattractive bund, swarming with ragged Hindus, and this either dusty or slippery with oily mud, is the invariable introduction.

A short walk across an open space, I almost said a park, partially shaded by some scraggly palms and illshapen acacias, leads one to a very mediocre hotel. The trees are soon more forcibly brought to one's attention, for toward eve I think every crow in Burma comes to this grove to roost—and caw. When one waits a bit too long before rising for the

IMAGES IN ONE OF THE CHAPELS WHICH SURROUND RANGOON

"chota-hazree," or early breakfast, on the porch outside one's bedroom, the probability that crows have keen eyes and empty stomachs becomes a self-evident truth. And so Rangoon, with its nondescript architecture and its polyglot crowds, fails to more than disappoint the most easily pleased.

But this tale is not yet ended! On a low, green hill bowered in grateful shade stands one of those splendid monuments which Buddhists raise—the most glorious, overwhelming shrine of all Indo-China, the very high-water mark of the art and architecture of Burma. Imagine a gracefully tapering spire, gilded over all and surmounted by its *hti* or umbrella of skillfully wrought and gilded metal;

ANOTHER VIEW OF THE SHRINES ON THE PLATFORM OF THE SCHWAY DAGON

DETAIL OF CARVING ON AN ENTRANCE TO A CHAPEL

A yellow-robed monk in foreground. They wear their robe like the Roman toga

hang on this *hti* a chime of bells which may be tinkled by the gentlest breeze; think of the spire surrounded by scores of shrines of every sort, decorated with mosaics and richest teak-wood carvings, and then remember that the summit of the great central mass is higher than the top of the cathedral of Saint Paul in London.

No words, however, can do justice to Schway Dagon. Guarded by its characteristic leogryphs and built upon a mound, with groves of graceful palms, it started ages ago as a modest stupa-like mass of brick. It was not allowed by the Burmese to crumble to decay, as is the ordinary pagoda, built today as an act of merit, for nowadays there is little to be gained by repairs. The building is what counts hereafter. But what other pagoda sheltered actual relics not only of Gautama, but of three preceding Buddhas?

Tradition says that men bearing eight hairs from Gautama's beard determined to bury them on this site, where other

A BURMESE FERRY BOAT

This curiously shaped sampan is the river ferry of the common people. The man rows standing up and pushes against the oars

relics already rested, and that in 588 B. C. the original pagoda, about 30 feet high, was erected. This has been cased over by successive layers till now it has a circumference of 1,355 feet and towers 370 feet in air. It is kept brilliantly gilded by subscriptions from the faithful. The surmounting umbrella was made from material valued at $250,000, given by Mindon Min when king of Upper Burma. The labor was voluntary, so the making cost nothing.

The many surrounding pagodas and shrines vary so in size, shape, and style that their description belongs only to the detailed guide-book. Suffice it to say that the near-by view is most impressive about dark, when beggars and candle grease are not very evident. Then the shadowy forms of the praying people and the quiet chanting of the monks cause one to stand still, and the true glory of the Schway Dagon pierces one's inner being as does the heavy booming of a great cathedral bell.

The people who are known today as Burmese are themselves a composite people, but only the most skilled anthropologist or linguist is able to pick the true Burmese of Lower Burma from the Talaing. Their outward appearance is very similar and merits passing mention. Europeans will tell you that they have more than their share of the most common Eastern failing—laziness. This may be so with the men. They are nevertheless a race of true sportsmen, enjoying a good pony as we often think only a European can.

The women are the trades people of the whole country, and, as caste is non-existent, they are as free to live their own lives as with us. Neatly dressed in pleasing silk and linen they come nearer to our Western ideas of what a charming woman should be than do most Orientals.

The dress of the two sexes is essentially similar. Many of the illustrations show this more or less distinctly. A length of cloth with the ends sewn up,

MILITARY POLICE TAKING A BURMESE DACOIT TO HIS EXECUTION

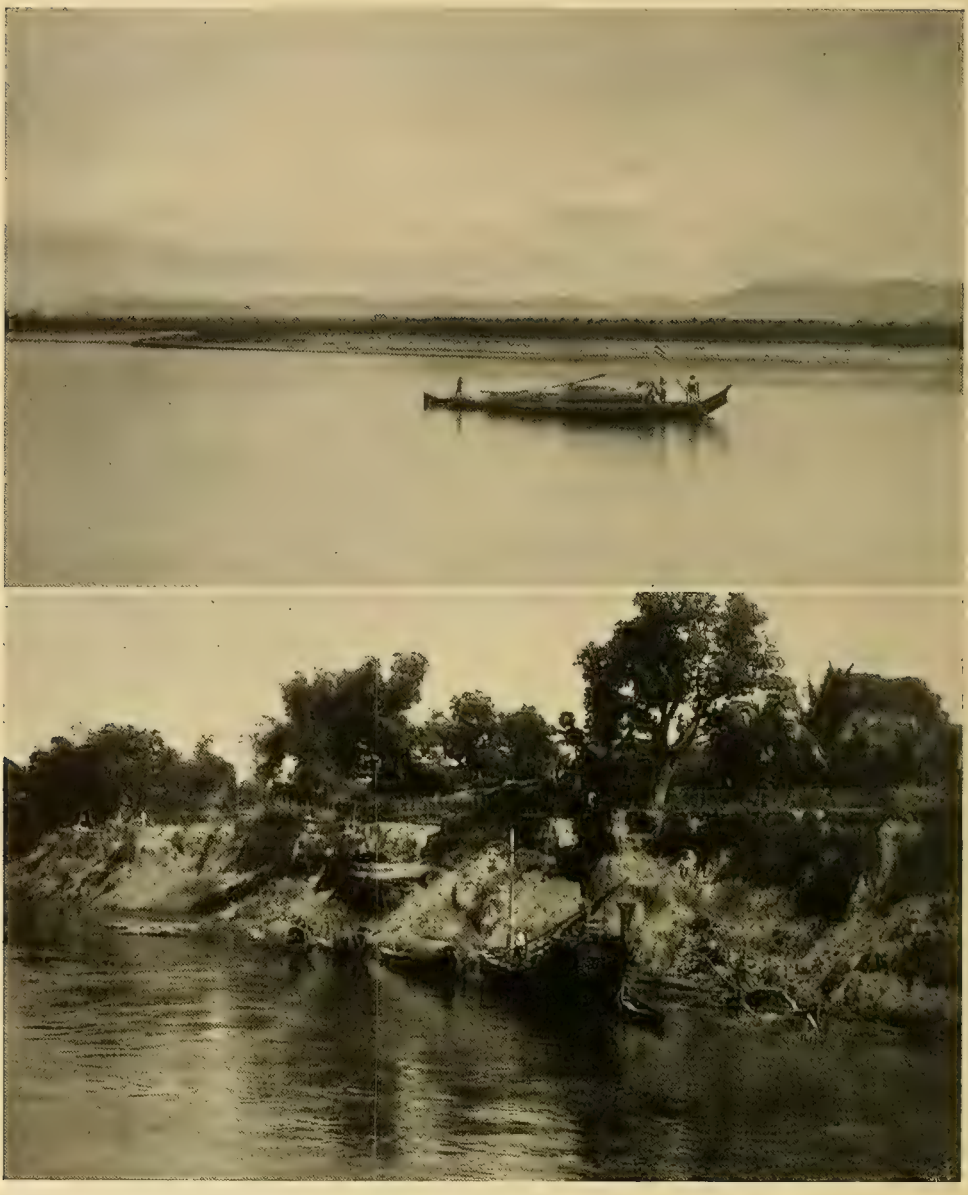
gathered about the body, forms a sort of skirt very like the well-known Malayan sarong. Men and women wear a clean loose linen jacket, and the men a gaudy silk handkerchief on their head. All smoke, and the "whacking white cheroot" of Kipling is simply a cylinder of rolled palm spath enclosing a quantity of ground-up pith and tobacco mixed—about the poorest treat I have ever tried At present the rather apathetic Burmese is going to the wall before the wave of migration from Hindustan. One cannot but hope, however, that he may be granted strength to prove the fittest to survive in his own land.

Next to the Burmese themselves, the most important people in Lower and Middle Burma are the various races which are grouped together under the generic name of Karen. These forest folk have come into special prominence because of the ease with which they have, many of them, been converted to Christianity. They have never been Buddhists, but have worshiped as a simple animistic cult. As Scott O'Connor, in "The Silken East," has said: "In the modern history of Christianity there is no more interesting episode than the conversion of the Karen. Prepared by prophecies current among them and by curious traditions of a biblical flavor, they embraced with fervor the new creed brought to them by the missionaries and there are today upwards of a hundred thousand Christian Karen in Burma." The photograph shows a couple of these folk who have come from the forests to Toungoo to make purchases for themselves and to see the railway.

Another important people are the Shan. Living as they do largely in the various Shan states, they are under the sovereignty of Britain, Siam, and China. They have split up into a number of tribes with distinct manners and customs. They wander about a good deal, and it is not unusual to see a party of Shans, in their quilted clothing and wearing big flapping straw hats, at the bazaar in Mandalay.

The Kachins, another fierce wild tribe, live in the hills along the border of the Chinese province of Yunnan. At first they are said to have been a peaceful, quiet folk, but persecutions which took place under the régime of the former kings of Upper Burma made of them a truculent and predatory people who were never conquered by the Burmese. The English have won them over to a great extent, and today the Kachin military police of Bhamo are one of the most interesting bodies in the heterogeneous Indian army.

EAGER CROWDS ON THE RIVER BANKS AWAIT THE STEAMER TO MAKE PURCHASES



A "PADY BOAT" FLOATING DOWN THE IRRAWADDY
Thousands of tons of rice are carried in this way from Upper Burma to Rangoon for export

ON THE UPPER REACHES OF THE IRRAWADDY
The current is swift and the river passes through several magnificent gorges. The height of the bank here shows the river's rise during the rains

SCENES ON THE IRRAWADDY

The river steamers do not run at night. Every evening some of the crew carry a line ashore in their teeth and the boat is moored to the bank for the night

Teak logs are so heavy that they will sink in water. For this reason they are rafted slung under bundles of bamboo

SHANS OF BURMA WITH THEIR FLAPPING STRAW HATS

VILLAGE SCENE IN UPPER BURMA

THE VILLAGE IMAGE OF THE BUDDHA

Moved in location, his head is shaded while a new roof is being built over him

MUD AND PLASTER SHRINES ABOUT THE TRUNK OF A SACRED TREE

Entrance to the compound of a Chinese merchant's house in Bhamo. The men are watching the operation of changing a kodak film.

The entrance to an ancient Chinese temple in Bhamo has this round hole. It is said that owing to their squarish outline devils cannot pass through a round door.

KARENS AT TOUNGOO WOMAN OF UPPER BURMA BURMESE LADY AT MANDALAY

WILD KACHINS AT BHAMO

The women wear silver hoops about their necks and many others that are not silver about their waists. Note the many hoops worn around the waist of the first figure on the left

COUNTRY FOLK COME TO BHAMO TO TRADE

Note the curious wicker basket, characteristic of these people

VIEWS OF THE QUEEN'S GOLDEN MONASTERY AT MANDALAY
Considered by many the best example of native architecture in all Burma

THE MOAT OF THE PALACE OF THE KINGS OF UPPER BURMA: MANDALAY: SUNSET

Looked up to with envy by their jungle neighbors, some of whom are always in Bhamo either trading or conferring with the deputy commissioner to settle tribal disputes, they seem to take a special pride in presenting arms as any European passes the guard-house.

Many of them bore and dilate the ear so that it is spread enough to carry a spindle of wood or roll of cloth an inch or more in diameter. They work cleverly in metal, and their heavy cutlasses, called "dahs," are carried over the shoulder by a strong bandoleer. The writer has seen these covered with pieces of tigers' jaws, the proud trophies of the owner. Over the border in Yunnan, Kachins and allied barbarians, called "Miaotsz" by the Chinese, are still the terror of their caravans. These wild tribes, of which there are more than eighty, are scattered over several Chinese provinces, and the study to determine the interrelationships of those mentioned with the Lolos, Shans, and Laotians forms one of the most intricate problems confronting anthropologists at the present time. Of the various Chin races and of the Salon I know nothing worth recording, for I have never even seen them.

The Chinese play an important rôle in the commercial life of Burma, and several ancient trade routes offer future promise of great value. The railway through the Shan states to Lashio can be brought to Chinese territory at any time the British so desire. While Bhamo itself, the highest military post on the Irrawaddy, has a decidedly Chinese look, its architecture and one of its temples suggested Wuchow in Kwang-si, while the hundreds of mules and ponies which hurry through the dusty streets, flogged along by lusty Chinamen, show one how the piece-goods of cotton from Manchester and Birmingham pass overland to where the name of England is but a shadowy myth.

The cotton comes to Bhamo in the steamers of the Irrawaddy Flotilla Company, which for many years has, extremely successfully, played an important part in the development of the land. The steamers, comfortable and clean, afford a

EARLY MORNING AMONG THE SIX HUNDRED PAGODAS OUTSIDE OF MANDALAY

endid way of seeing the country; the press boats for those whose time is rt; and, better still, the cargo boats ich tow alongside great bazaar flats l spend weeks in passing up and down river. The space on the flats is ated out in small parcels to storepers, who practically live permanently board them and who have their regucustomers in the various riverside villes. By traveling in these one may sure of seeing about all the folk in ery village passed, as well as having asonably lengthy stays at all the larger wns.

Perhaps the most remarkable "sight" the upper river above Mandalay is the finished Mingun pagoda, the largest lid mass of masonry in the world. ear by, under a huge roof and slung to giant beam of teak, hangs the largest rfect bell in the world. The great oken bell of Moscow only is larger.

Buddhism in a comparatively pure rm is the religion of the Burmese. very Burman dons the yellow robe of e monk for part of his life and these ngyis, as they are called, partially justify their somewhat vampire-like existence by keeping alive the rather feeble flame of native education. Many are monks for life, and these with their neophytes live in the pongy kyaungs which are scattered over the whole country. These monasteries serve as rest-houses for pilgrims, and in very many cases are remarkable examples of the characteristic architecture.

The finest of all is the Queen's Golden Monastery at Mandalay, which is here inadequately illustrated. The rich carvings and the gilt now dulled by time give a particularly pleasing and venerable appearance to the building. Native architecture is fast on the decline, however, since Theebaw's reign has ended, very ingloriously, the independent line of Burmese kings. Yet a new land to England, the government has not awakened to the fact that the palaces and formerly royally protected monasteries, of Mandalay especially, need restoring and preserving. The religious spirit of the people cares for the greater pagodas, while the less important ones, overgrown with luxuriant tropical foliage, make pleasing ruins.

The wooden buildings, however, really need the government's care, for they represent as truly the zenith of a people's development in architecture as do the more enduring but hardly more interesting remains in northern India, now so carefully protected. In this case also it is probable that considerable material help would be forthcoming from the richer natives.

THE AFGHAN BORDERLAND

By Ellsworth Huntington

Part II: The Persian Frontier

OUR first intimate contact with Afghanistan was at the fort of Zulfagar, in the northwest corner of the country, where Afghan territory touches Transcaspia on the north and Persia on the west. The Heri Rud River here forms the real boundary between Afghanistan and Persia, although the Afghans lay claim to a considerable area on the west bank. Among the barren Persian hills of white clay capped with a hard corniced layer of dark gravel, our caravan of horses and camels came winding down toward the tamarisk jungle which covers the flood-plain of the Heri Rud. Eastward on the other side of the river, undimmed by the clear December air, we saw a mud fort surrounded by flat-roofed mud houses at the foot of a fine cliff made up of many layers of horizontally bedded sandstone and shale.

At first the village appeared lifeless, but soon it became evident that our approach was noticed, for tiny figures, dwarfed by the deceptive distance, appeared on the higher roofs, and soon a string of white turbans and shining gun barrels could be seen bobbing riverward among the thick, dry tamarisk bushes.

When we emerged from the jungle on our bank of the river a group of soldiers stood opposite us across the broad, muddy stream, while one of their number, a heavy-featured man with well-oiled black hair and a sinister hairlip, was wading waist deep in the cold, swift current with his white nether garments of cotton flung over his shoulder. Coming ashore some distance below us, he clothed himself and forced his way through the bushes, breathing heavily from fear rather than exertion.

"Go away; you can't come here. This is Afghanistan," was his short and peremptory greeting. Our little Turkoman interpreter, Kurban of Serakhs, refused to hear what more he had to say, and sent him unwillingly back to call his chief, with whom alone, according to Oriental ideas, it was fit that foreigners should parley. There was much running to and fro on the other side, with the result that at length a portly man in voluminous white cotton trousers, a huge white turban, and a dark military cloak appeared on the Afghan bank.

"What do you want? What right have you to come here?" he shouted across the broad river in reply to Kurban's flattering inquiry as to his health and happiness.

"Most noble and worthy captain," answered Kurban, with Eastern exaggeration, "my masters are a renowned Russian general, most rich and valiant, and highly in favor with the great Tsar, and a learned American 'Khoja,' who knows all books and can read anything that was ever written. They intend to travel across Afghanistan, and therefore bespeak your hospitality."

"Send them away; send them away. They can't come here," was the captain's quick answer, but, bethinking himself,

ıe added: "Have the most honorable ravelers had a comfortable journey? Most gladly would I receive them, but I ım a mere captain. If I let them so nuch as set foot on this side of the river, ny king, the great Amir at Kabul, would cut my head off."

Persuasion was useless; the captain would neither permit us to cross nor accept our invitation to come over into Persia and dine with us. He seemed to stand in thorough terror of the Amir's anger.

We might have crossed without permission, but that would probably have necessitated fighting; for during the next two days, as we marched southward, armed soldiers appeared whenever the windings of the road brought us within sight of the river which forms the boundary for some fifty miles.

A few days later we made another attempt to enter Afghanistan, not with the intention of actually going far into the country, but because my Russian companion was extremely eager to learn something as to the defenses of Kafir Kala, a famous fort supposed to be the strongest on the western frontier of Afghanistan. Sending the camels safely into Persian territory, we started for Kafir Kala one glorious December day—the Russian official and his Turkoman soldier, the writer and his Russian servant, and our Turkoman interpreter—five men, well armed and mounted on good horses. Till noon we rode at a steady jog-trot through an uninhabited desert studded with low, dry bushes. Only twice did travelers appear in the narrow path, and they seemed sadly frightened. We began to think we had lost the road. Then a village came into view across the plain among the tamarisk bushes. Could that treeless group of low, gray walls and flat-roofed mud houses be Kafir Kala? Perhaps those turbaned men running together in the distance were soldiers. Something like gun barrels glistened over their shoulders. Riding nearer we saw that the village was evidently not a fort; but the way in which the villagers gathered in the road to intercept us looked ominous, even though the weapons over their shoulders were only spades for irrigating. As we turned away from their almost violent questions, a handsomely dressed young chief and two soldiers galloped up with a great show of guns, and we stopped perforce to parley in the middle of the village.

"This is Afghan territory. You are foreigners, and you must go back where you came from," began the chief.

"We understand all that," was the answer, "but we are going to call on the commandant at Kafir Kala. Where's the road?"

"There," pointing in the right direction, "but I won't let you go."

"Thank you. Who is this young man?" we asked, ignoring him and turning to the bystanders.

"Hakim Khan, Hakim Khan, the chief of Kuzzil Islam," came from a dozen voices. We understood now how he had happened to arrive. The old men whom we had met by the river an hour or two before had said that they came from Kuzzil Islam. Evidently they had turned back and given the alarm.

A hot discussion began at once between our men and the Afghans as to whether we should go back or keep on. We cut it short by turning our horses' heads toward the fort. That angered Hakim Khan. He said something sharp and short; the crowd surged forward, and half a dozen hands seized our bridles. Involuntarily we pulled out our pistols, and the crowd fell back in such haste that we could not help laughing to see them stumble over one another. That cleared the air, for the Afghans laughed, too, and we all grew friendly. We flattered the Khan by asking about the many villages which he owned and by expressing wonder at the extent of his travels to Cabul and Kandahar, and at his intimacy with the Amir.

"How much you have seen for so young a man," I said, and added the common Oriental question, "How old are you?"

"Fifteen years," was the absurd answer.

"I am a hundred," I rejoined.

He saw the point, and said hesitatingly: "Well, perhaps I am something over twenty. My age is written in a book, but the book is lost and it's a long time since I've seen it."

In spite of Hakim Khan's protestations, we at length set forward, accompanied by the chief and his two soldiers. When the fort came into sight a mile away we yielded so far as to let him send a man to announce our approach.

"Tell the commandant," we said, "that we have ridden far and are tired. We can talk business better if he has tea ready on our arrival."

The soldier dug his heels into his horse's flanks, the beast jumped, and the rider rolled ignominiously to the ground. His awkward way of mounting and the violent flapping of his legs as he once more got under way confirmed our impression that he was no cavalryman, and that if it came to shooting on horseback he would be more dangerous to his friends than to us. Nevertheless it was an anxious time as we watched him galloping wildly off. At length he reached the castle far away across the plain, and little black dots began to come out on the top of the crumbling old pile to look and disappear. Would we be received with tea and peace, or with soldiers and imprisonment? When finally we reached our destination, Hakim Khan led us up past the ruins of an older fort to the main entrance of the once stately castle, a handsome arch now falling to ruins.

In the doorway stood the commandant, a genuine old martinet, in an ancient British uniform of blue and gilt. His scraggly beard had been dyed some months before, according to the Persian fashion, but now had grown so much that a rim of newly grown gray hair intervened between his dark sun-tanned face and the bright red fringe of older hair, giving him a strangely simian aspect. An armed soldier stood on either side of the chief, while unarmed men lounged here and there. They might have had guns concealed under their long woolen cloaks, but there was no sign of armament except the two men beside the commandant, and a stack of four old-fashioned rifles to the right of the doorway. Through the door we caught a glimpse of tumble-down buildings surrounding a courtyard in the midst of which a single horse was conspicuously tied. To the left of the arch we gladly noticed an adobe platform spread with rugs, which suggested tea and a peaceful reception.

We were not left long in doubt, for the commandant sourly motioned to us to take places on the rugs with himself and Hakim Khan, while thirty or more soldiers ranged themselves cross-legged or asquat in a circle roundabout, and it became clear that they had no guns. At first one of the two armed soldiers stood respectfully opposite the chief, but soon sat down, while his comrade, who was supposed to be pacing before the gateway, often forgot his unaccustomed duty and stopped to listen. We endeavored to ascertain the Afghan attitude as to a certain disputed piece of territory which we really needed to cross for scientific purposes, but the only result was that an old private in the outside circle often took the words out of his superior's mouth, and the Russian official and the commandant kept contradicting one another in the "katydid" fashion of "It is." "It isn't."

By the time tea arrived it became evident that the Afghans were much more afraid of us than we of them. Kafir Kala, their boasted stronghold, was plainly defenseless. One can imagine the scene on the arrival of Hakim Khan's expert horsemen. The commandant hears the message in consternation and starts away to put on his faded uniform, but pauses to order tea and to direct that the six rifles be brought out. The four old-fashioned ones are to be stacked by the door; the two modern ones are to be carried by the soldiers whose nondescript garments most resemble uniforms. One of the two well-dressed men is to accompany

OLD AFGHAN CHIEFS BESIDE THEIR TENTS: A RUSSIAN OFFICER ON THE LEFT

AFGHAN CULTIVATORS AT A VILLAGE NEAR KAFIR KALA: THE MAN IN A SHEEPSKIN CAP IS A TURKOMAN

THE SOLDIERS OF HAKIM KHAN

HAKIM KHAN, THE AFGHAN CHIEF OF KUZZIL ISLAM, WITH ONE OF HIS SOLDIERS

KAFIR KALA, THE MOST IMPORTANT FORT ON THE WESTERN FRONTIER OF AFGHANISTAN

COMMANDANT AND SOLDIERS AT KAFIR KALA: IN THE BACKGROUND THE RUINS OF AN OLD FORT MAY BE SEEN

PROSPEROUS AFGHANS AND THEIR SONS

THE COMMANDANT OF KAFIR STANDING OUTSIDE THE WALLS OF THE FORT, WITH GUNS STACKED ON LEFT, AND ONE OF THE FEW UNIFORMED SOLDIERS ON RIGHT

A PERSIAN VILLAGE ON THE AFGHAN FRONTIER WITH A ROUND LOOP-HOLED TOWER OF STONES FOR PROTECTION AGAINST AFGHAN RAIDS

INHABITANTS OF THE VILLAGE WITH THE ROUND LOOP-HOLED TOWER

GATE OF THE FORT OF KAFIR KALA: RUSSIAN OFFICER AND TURKOMAN INTERPRETER AMONG A CROWD OF AFGHAN SOLDIERS

BAKING BREAD IN SEYISTAN ON THE AFGHAN BORDER

his chief, the other to play sentinel. While this is being arranged with the advice and consent of the whole garrison, the women go up on the roof to see what they can of the attacking army, and the small boys run to and fro and report progress.

When we bade the Afghans a friendly adieu after an hour's talk and some photography, we were put in charge of an escort, which consisted of a single ragged soldier, who accompanied us around the corner to point out the way back to Persia. Three months later, on our return from Seyistan by another route, we heard the sequel to our raid on Kafir Kala. The representative of the Persian foreign office at Birjand asked if it were true that Russia and Afghanistan were at war. He had heard, so he said, that Russia had sent a party of Cossacks to attack an Afghan fort, and many men had been killed in a bloody fight.

At Turbat the Russian consul, whose guests we were, had received a report that a Russian officer and his companion had been arrested and imprisoned by the Afghans. He at once sent one of his secret agents to Afghanistan to investigate the matter. From this man's report it appears that when news of our visit to Kafir Kala reached the authorities at Herat, the chief town of western Afghanistan, they summoned the commandant to give an account of himself. His inability to arrest us was clearly due to the fact that some higher official had squandered the money intended for the equipment of the fort. Some one, however, must be punished. The commandant was accordingly removed from office, publicly whipped, and sent to the smallest available post. A new man was sent to Kafir Kala, and with him a hundred well-armed cavalry, so it was said.

Evidently the Afghans have no intention of allowing foreigners to enter their country. The people of the west are by all accounts the mildest of the inhabitants of Afghanistan, but even they are by no means to be treated lightly, as we saw again and again. One day soon after our raid on Kafir Kala we stopped at a group of low, black tents belonging to Afghan nomads who were encamped in territory which is in dispute between Afghanistan and Persia. Being short of supplies, we bought a sheep and some bread, and at the same time procured a new guide. After purchases had been completed the caravan and the new guide started off across the desert hills, while the Russian official and I remained behind with the interpreter to pay the bill. The Afghans demanded an exorbitant price, which Kurban refused to pay. After an interminable dispute, we attempted to cut the matter short by handing over the money.

"Here," we said, "is twice the price of the sheep. We are willing to pay so much, but not ten or even five times its market value," and with that we started to ride away. Thereupon a black-browed Afghan seized the bridle of the interpreter's horse, which caused the Russian to ride his horse at the man to frighten him. The Afghans at once became excited and ran to the tents for their guns, while we began to ride slowly away. They came out ready to shoot and we looked for grave trouble, but a woman called out: "Don't shoot, don't shoot. If you kill one of them, their men will kill my husband, who has gone with them as guide."

We got away safely, but the guide proved most unsatisfactory. Twice he misled us, and instead of taking us to villages or nomad encampments brought us to desolate springs in the wilderness after we had stumbled through darkness for three or four hours. At the second spring we found ourselves short of bread, although we had meat enough to keep us from suffering. That night a caravan of Afghan salt-gatherers came along the same track that we had followed and encamped about a third of a mile away. In the morning our men went promptly to buy bread of them, but did not succeed in getting any. "Oh, yes," said the Afghans, "we have flour enough, but we do not care to sell it."

Naturally our men came back in rather

bad humor. They were talking of the meanness of the caravan men when some of the Afghans were seen coming toward the spring with buckets in their hands.

"Ah," said one of our Turkomans, "I know what we can do. We will not let them get any water until they sell us some bread."

Accordingly our men all got out their guns and stood around the spring to warn the Afghans off. At first the Afghans thought it was a joke, and so did we. They went off apparently to get some flour, but it soon appeared that they had no intention of satisfying the needs of our men. On the contrary they came strolling back to the number of fifteen or twenty, not carrying food, but grasping something long and hard under their long gray gowns of wool. Evidently they had brought their guns and meant to fight if necessary. It was a case of food against water. To allow a quarrel to arise there in the wilderness would have been suicidal. We called our men to their senses and let the Afghans get what water they needed.

During the next hour or two we made friends with them, and then they voluntarily offered us some bread. The method of cooking it was very different from that employed in the oases, where ovens of mud shaped like beehives, with a hole in the top, are heated with a fire of weeds, and the dough is stuck against the inside of the hot oven, where it hangs until it is so far cooked that it falls down into the ashes. The bread of the Afghan caravan was cooked by heating small, round cobblestones in the fire and then poking them out and wrapping dough an inch thick about them. The balls thus formed were again thrown into the fire to be poked out again when cooked. The bread tasted well there in the desert, although in civilized communities the grit and ashes would have seemed unendurable.

After good-fellowship had been established the Afghans actually sold us some flour. The camp where we used it a little later happened to be beside the sandy bed of a trickling salt stream, which was drinkable in winter, but absolutely unusable in summer, when evaporation is at its height and the salt is concentrated.

"See," said one of our Turkomans, as we dismounted, "here is some sand. Tonight we can have some good bread."

When some dry twigs had been gathered he proceeded to smooth off a bit of the cleanest sand and built upon it a hot fire. When the sand was thoroughly hot he raked off most of the coals and smoothed the sand very neatly. Meanwhile one of the other men had made two large sheets of dough about three-quarters of an inch thick and eighteen inches in diameter. Between these he placed a layer of lumps of sheep's tail fat, making a huge round sandwich. This was now spread on the hot sand, coals mixed with sand were placed completely over it, and it was left to bake. Now and then an edge was uncovered, and a Turkoman smelled it appreciatively and rapped on it to see if it was yet cooked. When the top was thoroughly baked the bread was turned over and covered up again. It tasted even better than the Afghan bread, after it had cooled a little and the sand and ashes had been whisked off with a girdle. The Turkomans are so accustomed to life in the sandy desert that they think it impossible to make the best kind of bread without sand, while the Afghans, who live in the stony mountains, think that cobblestones are a requisite.

The Afghans, like the Persians, have developed some of their worst characteristics largely by reason of the hardness of the physical conditions under which they live. The experiences described above took place on the borders of the Desert of Despair, a place where men and animals die of hunger and thirst and their companions have no pity. The caravan with which our men tried to quarrel was about to return across the northern edge of the desert with salt from the Lake of Khaf to be sold in Afghanistan. They reported that on the outward journey they had been delayed and two of their number had died of hunger.

MAT HENSON, THE FAITHFUL COLORED MAN WHO HAS MADE SO MANY TRIPS WITH COMMANDER PEARY

THE COAST OF SOUTH GREENLAND JUST AT THE ARCTIC CIRCLE, NEAR THE DANISH SETTLEMENT OF HOLSTENBORG

The growth of moss in this region is remarkable, at some places over a foot in height. There are numerous trees found which never reach more than 3 feet in height, usually only 15 inches; they are the birch and willow. This picture contrasts with the following one, on page 879.

THE COAST OF NORTHUMBERLAND ISLAND NEAR THE NORTHWESTERN END

Here are seen numerous small glaciers coming down from the ice-cap almost to the water's edge. The illustration also shows the terminal moraine

SOUTH GREENLAND ESKIMOS OF THE SETTLEMENT OF DISCO

This shows very plainly the intermixture of native and Danish blood. Several of the bead collars are well shown; also the decoration of the long sealskin boots of the women

In contrast is seen a typical group of north Greenland Eskimos, taken at the village of Karnah, this, as in the preceding picture, showing only the women and children. The clothing seen here is mostly of sealskin, though the boys have bearskin pants; some of the women have trimmings of blue fox skin. In the background is seen one of their tents or tupics.

A CURIOUS WATERFALL SPRINGING FROM THE END WALL OF A LARGE GLACIER

At the time this picture was taken the temperature was 42° F., and the ice on the surface of the glacier was melting so rapidly that the waterfall was formed. The dark portion below the water is not a cave, but clear blue-black ice

THE FORBIDDING COAST OF HAKLUYT ISLAND, INGLEFIELD GULF
These rocks are, however, the homes of countless birds

SENTINAL NUNATACK AT THE HEAD OF BOWDOIN BAY, WITH THE BOWDOIN GLACIER AT ITS FOOT

SIDE WALL OF THE BOWDOIN GLACIER

Showing the stratification of the glacier and the weathering due to the melting snow surface. The stream running at its foot comes from the melting of the glacier

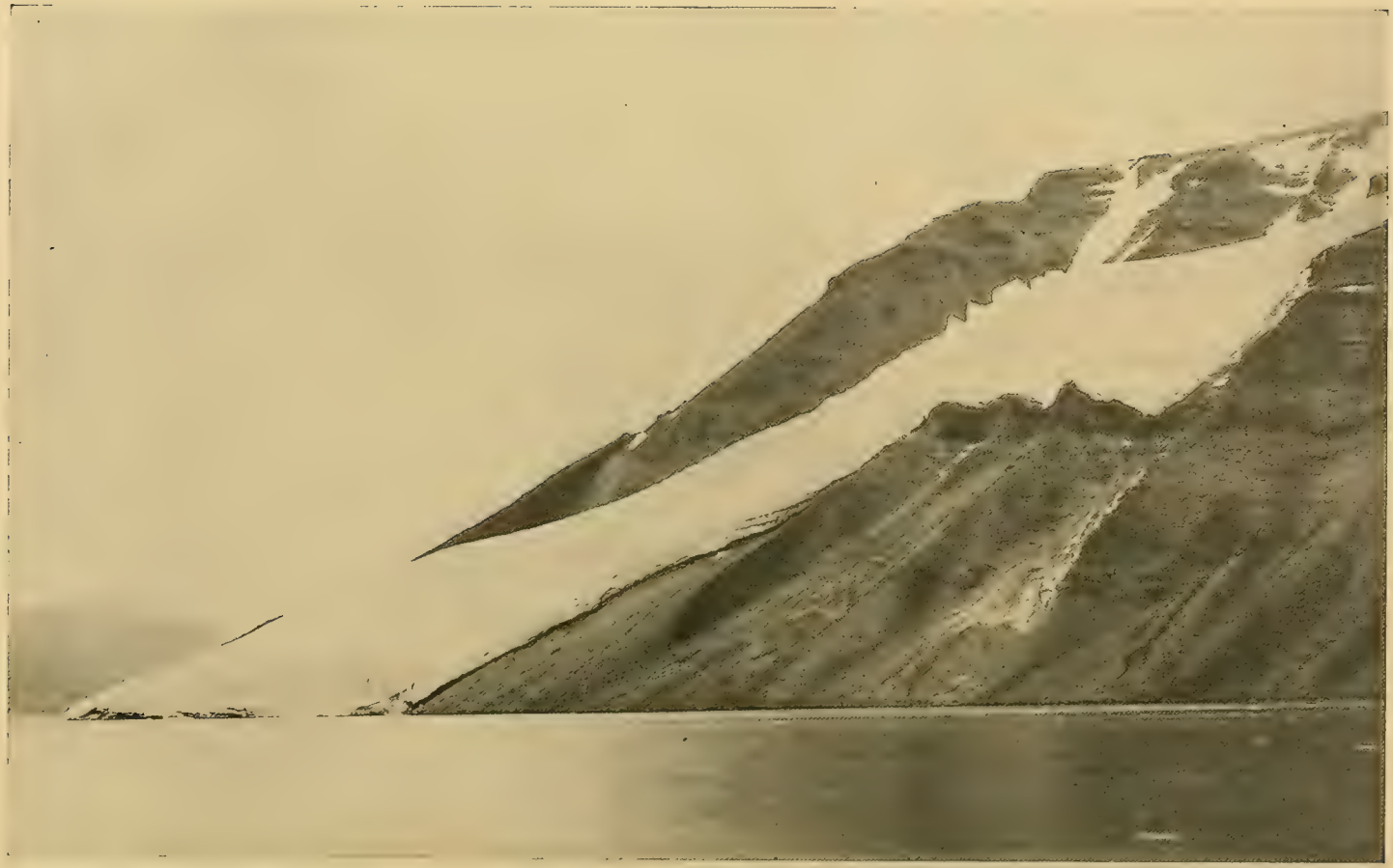
It was from this point that Commander Peary made his two successful sledge trips across the ice-cap of Greenland, each being over 1,000 miles in length, 1892 and 1895

Turning the camera from the spot where the last picture was taken, this arctic flower garden was found, the poppies predominating, mostly the yellow ones, though there are a few white with pale salmon-pink tinting

A FAMILY GROUP, NUCHTA, MISS BILL, HER TWO SISTERS AND STEPMOTHER

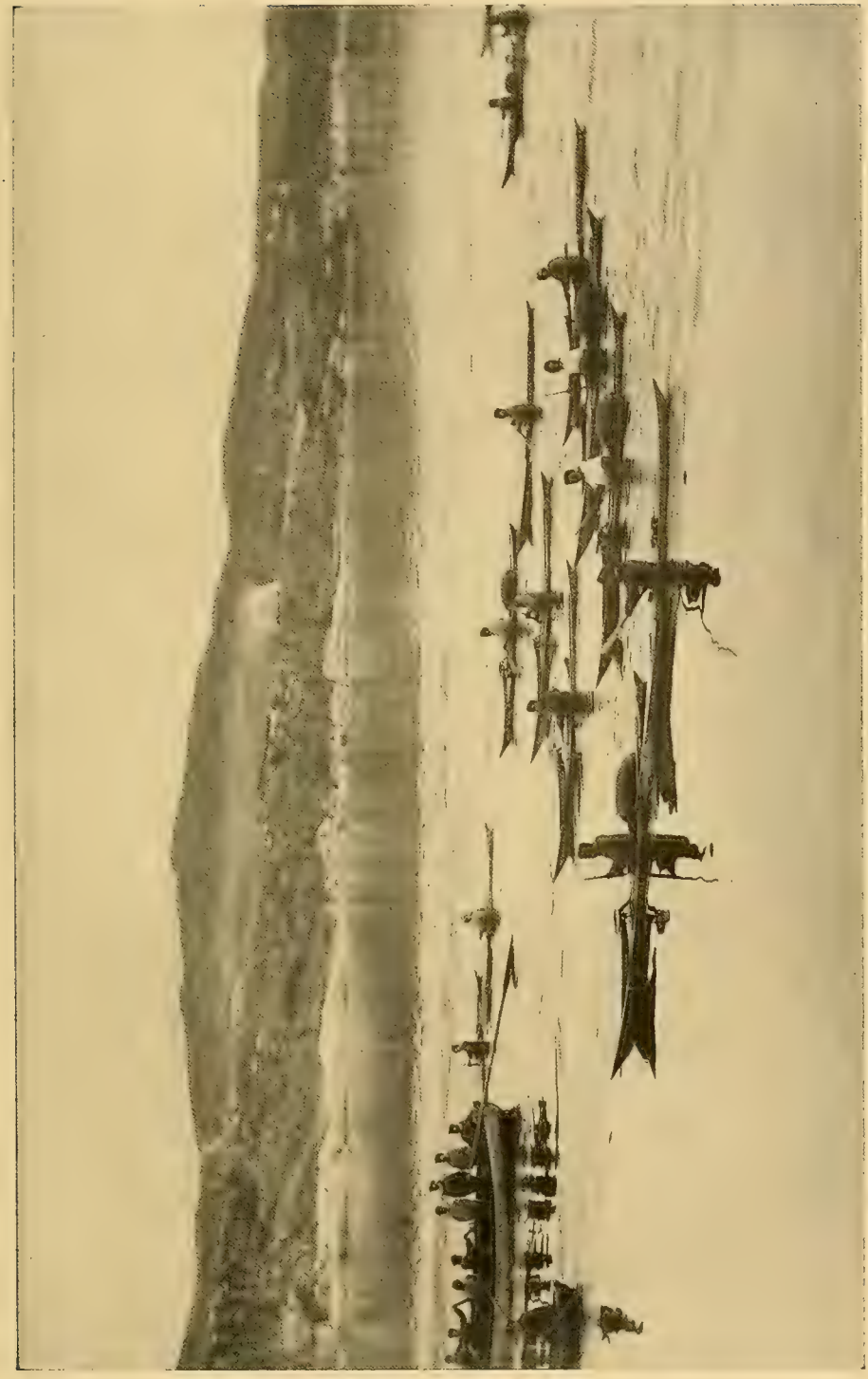
Miss Bill, the second figure on the left, is dressed in the costume of the south Greenlanders, as she had at that time just returned from her trip to the United States

A GROUP OF ESKIMO MEN, SHOWING COSTUMES AND HUNTING IMPLEMENTS



A SMALL RIBBON GLACIER, SHOWING THE FORMING OF CREVASSES BY ITS PASSING OVER DYKES OF HARD ROCK

The beautiful illustrations of scenery and Eskimo life in North Greenland, given on pages 877 to 891, are from photographs by Dr Theodore Le Boutillier, Secretary of the Geographical Society of Philadelphia. They were taken by him during a summer trip several years ago in one of Commander Peary's auxiliary expeditions, and are here published for the first time.



SOUTH GREENLAND ESKIMOS IN THEIR KAYAKS OR SKIN-COVERED BOATS

THE DISCOVERY OF THE POLE

WE print herewith the reports of Dr F. A. Cook and Commander Robert E. Peary announcing the discovery of the North Pole April 21, 1908, and April 6, 1909. Before the National Geographic Society can, however, accept the conclusions of either Commander Peary or Dr Cook that the North Pole has been attained, it will be necessary that the scientific records and data of each explorer be carefully examined by its Committee on Research or by some body or commission acceptable to the Board. The Society takes this position not from any distrust of the personal integrity of either explorer, but because of the many calculations that enter into the determination of the pole. The National Geographic Society urges Commander Peary and Dr Cook speedily to submit all their observations, notes, and data to a competent scientific commission in the United States.

First Report by Dr Frederick A. Cook, Sept. 1, 1909

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AFTER a prolonged fight against famine and frost we have at last succeeded in reaching the North Pole.

A new highway, with an interesting strip of animated nature, has been explored.

Big game haunts were located which will delight the sportsman and extend the Eskimo horizon.

Land has been discovered upon which rest the earth's northernmost rocks.

A triangle of 30,000 square miles has been cut out of the terrestrial unknown.

The expedition was the outcome of a summer cruise in Arctic seas. The yacht *Bradley* arrived at the limits of navigation in Smith Sound late in August, 1907. Here conditions were found favorable to launch a venture for the pole.

Mr John R. Bradley liberally supplied from the yacht suitable provisions for local use, and my own equipment for emergencies served well for every purpose of Arctic travel.

Many Eskimos had gathered on the Greenland shores at Annootok for the winter bear hunt. Immense caches of meat had been gathered. About the camp were plenty of strong dogs.

The combination was lucky, for there was good material for an equipment, expert help, and an efficient motor force, and all that was required was conveniently arranged at a point only 700 miles from the boreal center.

A house and workshop was built of packing boxes. The willing hands of this northernmost tribe of 250 people were set to the problem of devising a suitable outfit, and before the end of the long winter night we were ready for the enterprise.

Plans were matured to force a new route over Grinnell Land and northward along its west coast out on the polar sea.

Soon after the polar midnight the campaign opened. A few scouting parties were sent over to the American shores to explore a way and to seek game haunts.

Their mission was only partly successful, because storms darkened the January moon.

At sunrise of 1908 (February 19) the main expedition embarked for the pole. Eleven men and 103 dogs, drawing 11 heavily loaded sledges, left the Greenland shore and pushed westward over the troubled ice of Smith Sound.

The gloom of the long night was relieved by only a few hours of daylight. The chill of winter was felt at its worst.

As we crossed the heights of Ellesmere Sound to the Pacific slope the temperature sank to 83 degrees below zero Fahrenheit. Several dogs were frozen, and the men suffered severely, but we soon found game trails along which an easy way was forced through Nansen Sound to the land's end.

In this march were procured 101 musk oxen, 7 bears, and 335 hares, and then we pushed out into the polar sea from the southern point of Heiberg Island.

On March 17 six Eskimos returned from here, with four men and forty-six dogs, moving supplies for eighty days.

The crossing of the circumpolar pack was begun three days later. Two other Eskimos, forming the last supporting party, returned. The trains had now been reduced by the survival of the fittest. Etukishook and Ahwelah, the two best men, and twenty-six dogs were picked for the final dash. There was before us an unknown line of 460 miles to our goal.

The first days prevented long marches, and with encouraging progress the big lead which separated the land ice from the central pack was crossed with little delay.

Low temperature and persistent winds made life a torture, but, cooped in snow houses, eating dried beef and tallow and drinking hot tea, some animal comforts were occasionally to be gained.

For several days after the sight of known land was lost the overcast skies prevented an accurate determination of our positions.

On March 30 the horizon was partly cleared of its smoky agitation, and over the western mist was discovered a new land.

The observations gave our position latitude 84 deg. 17 min., longitude 86 deg. 36 min.

The urgent need of rapid advance on our main mission did not permit a detour to explore the coast.

Here were seen the last signs of solid earth. Beyond there was nothing stable, and even on scaling nothing was noted to mark the terrestial polar solidity.

We advanced steadily over the monotony of a moving sea of ice.

We now found ourselves beyond the range of all life. Neither the footprints of bears nor the blowholes of seals were detected. Even the microscopic creatures of the deep were no longer under us.

The maddening influence of the shifting desert of frost became almost unendurable in the daily routine. The surface of the pack offered less and less trouble. The weather improved, but still there remained a light life-sapping wind, which drove despair to its lowest recess.

Under the lash of duty, however, interest was forced, while the merciless drive of extreme cold enforced physical action.

Thus, day after day, the weary legs were spread over big distances.

The incidents and the positions were recorded, but the adventure was promptly forgotten in the mental bleach of the next day's effort.

The night of April 7 was made notable by the swing of the sun at midnight over the northern ice.

Sunburns and frost-bites were now recorded on the same day, but the double days of glitter infused quite an incentive into our life of shivers.

Observations on April 8 placed our camp at latitude 86 deg. 36 sec., longitude 94 deg. 2 sec.

In spite of what seemed like long marches, we had advanced but a little more than 100 miles in nine days.

Much of our hard work was lost in circuitous twists around troublesome pressure lines and high, irregular fields of very old ice.

The drift, too, was driving eastward with sufficient force to give some anxiety, though we were still equal to about fifteen miles daily.

The extended marches and the long hours of travel with which fortune had favored us earlier were no longer possible.

We were now about 200 miles from

the pole and the sled loads were reduced. One dog after another had gone into the stomachs of his hungry survivors until the teams were considerably reduced, but there seemed to remain a sufficient balance of man and brute to push along into the heart of the mystery to which we had set ourselves.

Beyond the eighty-sixth parallel the icefields became more extensive and heavier, the crevices fewer and less troublesome, with little or no crushed ice thrown up as barriers.

From the eighty-seventh to the eighty-eighth, much to our surprise, was the indication of land ice.

For two days we traveled over ice which resembled a glacial surface. The usual sea ice lines of demarkation were absent and there were no hummocks or deep crevices.

There was, however, no perceptible elevation and no positive sign of land or sea.

Observations on the 14th gave latitude 88 deg. 21 min. and longitude 95 deg. 52 min.

We were now less than one hundred miles from the pole.

The pack was here more active, but the temperature remained 40 below zero, cementing together quickly the new crevices.

Young ice spread on the narrow spaces of open water so rapidly that little delay was caused in crossing from one field to another.

The time had now arrived to muster energy for the last series of efforts.

In the enforced effort every human strand was strained, and at camping time there was no longer sufficient energy to erect a snow shelter, though the temperature was still very low.

The silk tent was pressed into service and the change proved agreeable. It encouraged a more careful scrutiny of the strange world into which fate had pressed us.

Signs of land were still seen every day, but they were deceptive illusions or a mere flight of fancy.

It seemed that something must cross the horizon to mark the important area into which we were pushing.

When the sun was low the eye ran over the moving plains of color to dancing horizons. The mirages turned things topsy turvy. Inverted mountains and queer objects ever rose and fell in shrouds of mystery, but all of this was due to the atmospheric magic of the midnight sun.

Slowly but surely we neared the turning point. Good astronomical observations were daily procured to fix the advancing stages.

The ice steadily improved, but still there was a depressing monotony of scene, and life had no pleasures, no spiritual recreation, nothing to relieve the steady physical drag of chronic fatigue.

But there came an end to this as to all things. On April 21 the first corrected altitude of the sun gave 89 deg. 59 min. 46 sec.

The pole, therefore, was in sight.

We advanced the fourteen seconds, made supplementary observations and prepared to stay long enough to permit a double round of observations.

Etukishook and Ahwelab were told that we had reached the "Neig Nail" and they sought to celebrate by an advance of savage joys.

At last we had pierced the boreal centre and the flag had been raised to the coveted breezes of the North Pole.

The day was April 21, 1908. The sun indicated local noon, but time was a negative problem, for here all meridians meet.

With a step it was possible to go from one part of the globe to the opposite side.

From the hour of midnight to that of midday the latitude was 90, the temperature 38 and the barometer 29.83.

North, east and west had vanished. It was south in every direction, but the compass pointing to the magnetic pole was as useful as ever.

Though overjoyed with the success of the conquest, our spirits began to descend on the following day. After all the observations had been taken with a careful study of the local conditions a sense of

intense loneliness came with the further scrutiny of the horizon.

What a cheerless spot to have aroused the ambition of man for so many ages!

An endless field of purple snows. No life. No land. No spot to relieve the monotony of frost. We were the only pulsating creatures in a dead world of ice.

We turned our backs to the pole on April 23 and began the long return march. Counting on a continued easterly drift, the course was forced further west.

With fair weather, good ice and the inspiration of the home run, long distances were at first quickly covered.

Below the eighty-seventh parallel the character of the ice changed very much, and it became evident that the season was advancing rapidly.

With a good deal of anxiety we watched the daily reduction of the food supply.

It now became evident that the crucial stage of the campaign was to be transferred from the taking of the pole to a final battle for life against famine and frost.

The clear blue of the skies changed to a steady, dismal gray. Several days of icy despair followed each other in rapid succession.

There were some violent gales, but usually the wind did not rise to the full force of a storm.

With starvation as the alternative, we could not wait for better weather.

Some advance was made nearly every day, but the cost of the desperate effort pressed life to the verge of extinction.

On May 24 the sky cleared long enough to give us a set of observations.

We had reached the eighty-fourth parallel near the ninety-seventh meridian. The ice was much broken and drifted eastward, leaving many open spaces of water.

There remained on our sleds scarcely enough food to reach our caches on Nansen Sound unless we averaged fifteen miles daily. With the disrupted "lalack" and reduced strength we were hardly equal to ten miles daily.

Trying to make the best of our hard lot, a straight course was set for the musk ox lands of the inner crossing.

At the eighty-third parallel we found ourselves to the west of a large tract, extending southward. The ice changed to small fields. The temperature rose to zero and a persistent mist obscured the heavens.

The events of the following day were pressed into desperate action.

With a few lines on paper to register the life of suffering, the food for man and dog was reduced to a three-quarter ration, while the difficulties of ice travel rose to disheartening heights.

At the end of a struggle of twenty days through thick fog the sky cleared and we found ourselves far down in Crown Prince Gustav Sea, with open water and impossible small ice as a barrier between us and Heiberg Island.

In the next few days bears came along as life savers. The empty stomachs were spread and the horizon, for a time, was cleared of trouble.

With the return to Annootok rendered difficult by the unfortunate westerly drift, we now sought to follow the ice movement south to Lancaster Sound, where we hoped to reach a Scottish whaler.

Early in July further southward progress became impossible, and in quest of food we crossed the Firth of Devon into Jones Sound.

The dogs were here given the freedom of their wolf propensities, and by folding boat and sled we tried to reach Baffin's Bay. With but an occasional bird to eat and a long line of misfortune we pushed eastward until the frost of early September stopped progress.

With neither food, fuel nor ammunition we were forced to wrest winter supplies from what seemed at first like a lifeless desert.

Pressed by hunger, new implements were shaped, and Cape Sparbo was picked as a likely place to find life.

Game was located with the bow and arrow, the line, the lance and the knife. The musk ox, bear and wolves yielded meat, skins and fat. An underground

den was prepared, and in it we remained until sunrise of 1909.

On February 18 the start was made for Annootok. With a newly prepared equipment the Greenland shores were reached on April 15.

Here we were greeted by Harry Whitney and an anxious group of Eskimo friends.

To facilitate an early return I moved southward to the Danish settlement and reached Upernavik on May 21, 1909.

First Report by Commander Robert E. Peary, U. S. N., September 6, 1909

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THE steamer *Roosevelt*, bearing the North Polar expedition of the Peary Arctic Club, parted company with the *Erik* and steamed out of Etah Fiord late in the afternoon of August 18, 1908, setting the usual course for Cape Sabine. The weather was dirty, with fresh southeasterly winds. We had on board twenty-two Eskimo men, seventeen women, and ten children, two hundred and twenty-six dogs, and some forty-odd walrus.

We encountered the ice a short distance from the mouth of the harbor, but it was not closely packed and was negotiated by the *Roosevelt* without serious difficulty. As we neared Cape Sabine the weather cleared somewhat, and we passed close by Three Voort Island and Cape Sabine, easily making out with the naked eye the house at Hayes Harbor occupied by me in the winter of 1901-'2.

From Cape Sabine north there was so much water that we thought of setting the lug sail before the southerly wind; but a little later appearance of ice to the northward stopped this. There was clean open water to Cape Albert, and from there scattered ice to a point about abreast of Victoria Head, thick weather and dense ice bringing us some ten or fifteen miles away.

From here we drifted south somewhat, and then got a slant to the northward out of the current. We worked a little further north, and stopped again for some hours. Then we again worked westward and northward till we reached a series of lakes, coming to a stop a few miles south of the *Windward's* winter quarters at Cape Derville.

From here, after some delay, we slowly worked away northeastward through fog and broken ice of medium thickness through one night and the forenoon of the next day, only emerging into open water and clear weather off Cape Fraser.

From this point we had a clear run through the middle of Robeson Channel, uninterrupted by either ice or fog, to Lady Franklin Bay. Here we encountered both ice and fog, and while working along in search of a practicable opening were forced across to the Greenland coast at Thank God Harbor. The fog lifted there, and enabled us to make out our whereabouts, and we steamed north through a series of leads past Cape Lupton, and thence southward toward Cape Union. A few miles off that cape we were stopped by impracticable ice, and we drifted back through to Cape Union, where we stopped again.

We lay for a time in a lake of water and then, to prevent being drifted south again we took refuge under the north shore of Lincoln Bay, in nearly the identical place where we had our unpleasant experiences three years before. Here we remained for several days during a period of constant and at times violent northeasterly winds.

Twice we were forced aground by the heavy ice; we had our port rail broken and a hole in the bulwark, and twice we pushed out in an attempt to get north,

but we were forced back each time to our precarious shelter.

Finally on September 11 we squeezed around Cape Union and made fast in a shallow niche in the ice, but after some hours we made another short run to Black Cape, and hung on to a grounded bit of ice. At last, a little after midnight of September 5, we passed through extremely heavy running ice into a stream of open water, rounded Cape Union, and passed Cape Sheridan.

Within a quarter of an hour of the same time we arrived three years before, 7 a. m., September 5, we reached the open water extending beyond Cape Sheridan. We steamed up to the end of it, and it appeared practicable at first to reach Porter Bay, near Cape Joseph Henry, which I had for my winter quarters. But the outlook being unsatisfactory, I went back and put the *Roosevelt* into the only opening in the floe, being barred close to the mouth of the Sheridan River, a little north of our position three years ago.

The season was further advanced than in 1905, there was more snow on the ground, and the new ice inside the floe bergs was much thicker.

The work of discharging the ship was commenced at once, and rushed to completion. The supplies and equipment we sledded across ice and sea and deposited on shore. A house and workshop were built of board, covered with sails, and fitted with stoves, and the ship was snug for winter in shoal water, where she touched bottom at low tide. This settlement on the stormy shores of the Arctic Ocean was christened Hubbardville.

A hunting party was sent out on September 10, and a bear was brought in on the 12th, and some deer a day or two later.

On September 15 the full work of transporting supplies to Cape Columbia was commenced. Marvin, with Doctor Goodsell and Borup and the Eskimo, took sixteen sledges of supplies to Cape Belknap, and on the 25th the same party started with loads to Porter Bay. The work of hunting and transporting supplies was prosecuted continuously by the members of the party and the Eskimos until November 5, when the supplies for the spring sledge trip had been removed from winter quarters and deposited at various places from Cape Colan to Cape Columbia.

In the latter part of September the movement of the ice subjected the ship to a pressure which listed her to port some 8 or 10 degrees, and she did not recover till the following spring.

On October 11 I went on a hunt with two Eskimos across the ice field and Parr Bay and the peninsula, made the circuit of Clements Markham Inlet, and returned to the ship in seven days with fifteen musk oxen, a bear, and a deer. Later in October I repeated the trip, obtaining five musk oxen, and hunting parties secured some forty deer.

Professor McMillan went to Columbia in November and obtained a month of tidal observations, returning in December. In the December moon Borup moved the Hecla depot to Cape Colan; Bartlett made a hunting trip overland to Lake Hazen, and Hensen went to Clements Markham Inlet. In the January moon Marvin crossed Robeson Channel and went to Cape Bryant for tidal and meteorological observations. Bartlett crossed the channel and made the circuit of Newman Bay and explored the peninsula. After he returned Goodsell went to Markham Inlet and Borup toward Lake Hazen, in the interior, on hunting trips.

In the February moon Bartlett went to Cape Hecla, Goodsell moved some more supplies from Hecla to Cape Colan, and Borup went to Markham Inlet on a hunting trip. On February 15 Bartlett left the *Roosevelt* with his division for Cape Columbia and Parr Bay; Goodsell, Borup, McMillan, and Hensen followed on successive days with their provisions. Marvin returned from Cape Bryant on February 17, and left for Cape Columbia February 21. I brought up in the rear February 22.

The total of all divisions leaving the *Roosevelt* were 7 members of the party,

59 Eskimos, 140 dogs, and 23 sledges. By February 27 such of the Cape Colan depot as was needed had been brought up to Cape Columbia, the dogs were rested and double-rationed and harnessed, and the sledges and other gear overhauled.

Four months of northerly winds during the fall and winter, instead of southerly ones, as during the previous season, led me to think that I would meet less water than before, but a great deal of rough ice, and I was prepared to hew a road through the jagged ice the first hundred miles or so, and then cross the big lead.

On the last day of February Bartlett, with his pioneer division, got away due north over the ice. On March 1 the remainder of the party got away on Bartlett's trail, and I followed an hour later.

The party now comprised 7 members of the expedition, 17 Eskimos, 133 dogs, and 19 sledges. One Eskimo and seven dogs had gone to pieces. A strong easterly wind, drifting snow, and temperature in the minus marked our departure from the camp at Cape Columbia, which I had christened Crane City.

Rough ice in the first march damaged several sledges and smashed two beyond repairs, the teams going to Columbia for other sledges in reserve there.

We camped ten miles from Crane City. The easterly wind and low temperature continued. On the 2d of March we passed the British record made by Markham, in May, 1876—82.20—and were stopped by open water, which had been formed by the wind after Bartlett passed. In this march we negotiated the lead, and reached Bartlett's third camp. Borup had gone back from here, but missed his way, owing to the faulting of the trail by the movement of the ice.

Marvin came back also for more fuel and alcohol. The wind continued, forming open water all about us. At the end of the fourth march we came upon Bartlett, who had been stopped by a wide lake of open water. We remained here from March 4 to March 11.

At noon of March 5, the sun, red and shaped like a football by excessed reflection, just raised itself above the horizon for a few minutes, and then disappeared again. It was the first time I had seen it since October 1.

I now began to feel a good deal of anxiety because there were no signs of Marvin and Borup, who should have been there for two days. Besides, they had the alcohol and oil which were indispensable for us. We concluded that they had either lost the trail or were imprisoned on an island by open water, probably the latter.

Fortunately, on March 11 the lead was practicable, and leaving a note for Marvin and Borup to push on after us by forced marches, we proceeded northward. The sounding of the lead gave 110 fathoms. During this march we crossed the 84th parallel, and traversed a succession of just frozen leads from a few hundred yards to a mile in width. This march was really simple.

On the 14th we got free of the leads and came on decent going. While we were making camp a courier from Marvin came, and informed me he was on the march in the rear. The temperature was 59 below zero.

The following morning, March 14, I sent Hensen with his division north to pioneer a trail for five marches, and Doctor Goodsell, according to the programme, started back to Cape Columbia. At night Marvin and Borup came spinning in with their men and dogs steaming in the bitter air like a squadron of battleships. Their arrival relieved me of all anxiety as to our oil supply.

In the morning I discovered that McMillan's foot was badly frost-bitten. The mishap had occurred two or three days before that, and McMillan had said nothing about it in the hope that it would come out all right. A glance at the injury showed me that the only thing was to send him back to Cape Columbia at once. The arrival of Marvin and Borup enabled me to spare sufficient men and dogs to go back with him.

This early loss of McMillan was seriously disappointing to me. He had a

sledge all the way from Cape Columbia, and with his enthusiasm and the powers and physique of the trained athlete I had confidence in him for at least the 86th parallel, but there was no alternative.

The best sledges and dogs were selected and the sledge loads brought up to the standard. The sounding gave a depth of 325 fathoms. We were over the continental shelf, and, as I had surmised, the successive leads crossed in the fifth and sixth marches composed the big lead and marked the continental shelf.

On leaving this camp the expedition comprised 16 men, 12 sledges, and 100 dogs. The next march was satisfactory as regards distance and character of going. In the latter part there were pronounced movements in the ice, both visible and audible. Some leads were crossed, in one of which Borup and his team took a bath, and we were finally stopped by an impracticable lead opening in front of us.

We camped in a temperature of 50. At the end of two short marches we came upon Hensen and his party in camp mending their sledges. We devoted the remainder of the day to overhauling and mending sledges and breaking up our damaged ones for material.

The next morning I put Marvin in the lead to pioneer the trail, with instructions to make two forced marches to bring up our average, which had been cut down by the last two short ones. Marvin carried out his instructions implicitly. A considerable amount of young ice assisted in this.

At the end of the 10th of March, in latitude 85.23, Borup turned back in command of the second supporting party, having traveled a distance equivalent to Nansen's distance from this far to his farthest north. I was sorry to lose this young Yale runner, with his enthusiasm and pluck. He had led his heavy sledge over the floes in a way that commanded every one's admiration, and would have made his father's eyes glisten.

From this point the expedition comprised 12 men, 10 sledges, and 70 dogs. It was necessary for Marvin to take a sledge from here, and I put Bartlett and his division in advance to pioneer the trail.

The continual daylight enabled me to make a moderation here that brought my advance and main parties closer together, and reduced the likelihood of their being separated by open leads.

Bartlett left camp with Henderson and their division; Marvin and I remained with our divisions twenty hours longer, and then followed. When we reached Bartlett's camp, he broke out and went on, and we turned in. By this arrangement the advance party was traveling while the main party was asleep, and *vice versa,* and I was in touch with my advance party every twenty-four hours.

I had no reason to complain of the going for the next two marches, though for a less experienced party, less adaptable sledges, or less perfect equipment it would have been an impossibility.

At our position at the end of the second march Marvin obtained a satisfactory sight for latitude in clear weather, which placed us at 85.48. This result agreed very satisfactorily with the dead reckoning of Marvin, Bartlett, and myself.

Up to this time the slight altitude of the sun had made it not worth while to waste time in observations.

On the next two marches the going improved, and we covered good distances. In one of these marches a lead delayed us a few hours. We finally ferried across on the ice cakes.

The next day Bartlett let himself out, evidently for a record, and reeled off plump twenty miles. Here Marvin obtained another satisfactory sight on latitude which gave the position as 86.38 (or beyond the farthest north of Nansen and Abruzzi), and showed that we had covered 50 minutes of latitude in three marches. In these three marches we had passed the Norwegian record of 86.14 by Nansen and the Italian record of 86.34 by Cagni.

From this point Marvin turned back in command of the third supporting

party. My last words to him were: "Be careful of the leads, my boy."

The party from this point comprised 9 men, 7 sledges, and 60 dogs. The conditions at this camp and the apparently unbroken expanse of fairly level ice in every direction reminded me of Cagni's description of his farthest north, but I was not deceived by the apparently favorable outlook, for favorable conditions never continue for any distance or any length of time in the Arctic regions.

The north march was very good going, but for the first time since leaving land we experienced that condition, frequent over these ice fields, of a hazy atmosphere in which the light is equal everywhere. All relief is destroyed, and it is impossible to see for any distance.

We were obliged in this march to make a detour around an open lead. In the next march we encountered the heaviest and deepest snow of the journey through a thick, smothering mantle lying in the depressions of heavy rubble ice. I came upon Bartlett and his party, fagged out and temporarily discouraged by the heart-racking work of making a road.

I knew what was the matter with them. They were simply spoiled by the good going on the previous marches. I rallied them a bit, lightened their sledges, and set them on encouraged again.

During the next march we traveled through a thick haze, drifting over the ice before a biting air from the northeast. At the end of the march we came upon the captain camped beside a wide-open lead, with a dense black water sky northwest, north, and northeast. We built our igloos and turned in, but before I had fallen asleep I was roused out by a movement of the ice, and found a startling condition of affairs.

A rapidly widening road of black water ran but a few feet from our igloos. One of my teams of dogs had escaped by only a few feet from being dragged by the movement in the ice into the water.

Another team had an equally narrow escape from being crushed by the ice blocks piled over them. The ice on the north side of the lead was moving around eastward. The small floes on which were the captain's igloos were drifting eastward in the open water, and the side of our igloos threatened to follow suit.

Kicking out the door of the igloos, I called to the captain's men to pack their sledges and be ready for a quick dash when a favorable change arrived.

We hurried our things on our sledges, hitched the dogs, and moved on to a large floe west of us. Then leaving one man to look out for the dogs and sledges, we hurried over to assist the captain's party to join us.

A corner of their raft impinged on the ice on our side for the rest of the night, and during the next day the ice suffered the torments of the damned, surging together, opening out, groaning and grinding, while the open water belched black smoke like a prairie fire. Then the motion ceased, the open water closed, the atmosphere to the north was cleared, and we rushed across before the ice should open again.

A succession of literally open leads were crossed, and after them some heavy old ice, and then we came to a layer of young ice, some of which buckled under our sledges, and this gave us a straight way of six miles to the north. Then came more heavy old floes covered with hard snow. This was a good, long march.

The next march was a long one. It was Bartlett's last hit. He let himself out over a series of large old floes, steadily increasing in diameter and covered with hard snow.

During the last few miles I walked beside him or in advance. He was very solemn and anxious to go further, but the programme was for him to go back from here in command of the fourth supporting party, and there were no supplies for an increase in the main party.

In this march we encountered a high wind for the first time since the three days after we left Cape Columbia. It was dead on our faces, bitter and insistent, but I had no reason to complain; it was better than an easterly or southerly wind, either of which would have set us

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ARCTIC HUNTERS AND ESKIMOS HAVING JUST LANDED THREE FINE SPECIMENS OF WALRUS

adrift in open water, while this was closing up every lead behind. This furnished another advantage of my supporting parties. True, by so doing, it was pressing to the south the ice over which we traveled, and so robbing us of a hundred miles of advantage.

We concluded we were on or near the 88th parallel, unless the north wind had lost us several miles. The wind blew all night, and all the following day. At this camp in the morning Bartlett started to walk five or six miles to the north, to make sure of reaching the 88th parallel. While he was gone I selected the forty best dogs in the outfit and had them doubled, and I picked out five of the best sledges and assigned them expressly to the captain's party. I broke up the tent for material with which to repair the others and set Eskimos at this work.

Bartlett returned in time to take a satisfactory observation for latitude in clear weather, and obtained for our position 87.48, that showed that the continued north wind had robbed us of a number of miles of hard-earned distance. Bartlett took the observation here, as had Marvin five camps back, partly to save my eyes, but largely to give an independent record and determination of our advance. The observations completed, and two copies made, one for him and the other for me, Bartlett started on the back trail in command of my fourth supporting party, with 2 Eskimos, 1 sledge, and 18 dogs.

When he left I felt for a moment the pangs of regret as he disappeared in the distance, but it was only momentary. My work was still ahead, not in the rear. Bartlett had done good work, and had been a great help to me. Circumstances had thrust the brunt of pioneering upon him instead of dividing it among several, as I had planned.

He had reason to take pride in the fact that he had bettered the Italian record by a degree and a quarter, and had covered a distance equal to the entire distance of the Italian expedition from Franz Josef's Land to Cagni's farthest north. I had

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SCENE ON SOUTH GREENLAND COAST, SHOWING THE ODD WAY THE ESKIMO WOMEN IN THIS LOCALITY DRESS THE HAIR

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AN ARCTIC EXPLORER COMING OUT OF A SNOW COVERED IGLOO: A WINTER HOME IN THE ARCTICS

given Bartlett this position and post of honor in command of my fourth and last supporting party, and for two reasons: First, because of his magnificent handling of the *Roosevelt;* second, because he had cheerfully stood between me and many trifling annoyances on the expedition.

Then there was a third reason. It seemed to me appropriate, in view of the magnificent British record of Arctic work covering three centuries, that it should be a British subject who could boast that next to an American he had been nearest the pole.

With the disappearance of Bartlett, I turned to the problem before me. This was that for which I had worked for thirty-two years; for which I had lived the simple life; for which I had conserved all my energy on the upward trip; for which I had trained myself as for a race, crushing down every worry about success.

For success now, in spite of my years, I felt in trim—fit for the demands of the coming days and eager to be on the trail. As for my party, my equipment and my supplies, I was in shape beyond my most sanguine dreams of earliest years. My party might be regarded as an ideal which had now come to realization—as loyal and responsive to my will as the fingers of my right hand.

Four of them carried the technique of dogs, sledges, ice, and cold as their heritage. Two of them, Hensen and Ootam, were my companions to the

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ESKIMOS ON THE ICE IN NORTH STAR BAY

farthest point three years before. Two others, Egingwah and Sigloo, were in Clark's division, which had such a narrow escape at that time, and now were willing to go anywhere with my immediate party, and willing to risk themselves again in any supporting party.

The fifth was a young man who had never served before in any expedition, but who was, if possible, even more willing and eager than the others for the princely gifts—a boat, a rifle, a shotgun, ammunition, knives, etc.—which I had promised to each of them who reached the pole with me; for he knew that these riches would enable him to wrest from a stubborn father the girl whose image filled his hot young heart.

All had blind confidence so long as I was with them and gave no thought for the morrow, sure that whatever happened I should somehow get them back to land. But I dealt with the party equally. I recognized that all its impetus centered in me and that, whatever pace I set, it would make good. If any one was played out, I would stop for a short time.

I had no fault to find with the conditions. My dogs were the very best, the pick of 122 with which we left Columbia. Almost all were powerful males, hard as nails, in good flesh, but without a superfluous ounce, without a suspicion of fat anywhere; and, what was better yet, they were all in good spirits.

My sledges, now that the repairs were completed, were in good condition. My supplies were ample for forty days, and with the reserve, represented by the dogs themselves, could be made to last fifty.

Pacing back and forth in the lee of the pressure ridge where our igloos were built, while my men got their loads ready for the next marches, I settled on my

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TWO POLAR BEARS HARPOONED BY ESKIMOS AND BROUGHT ABOARD AT BLACK LEAD, EAST GREENLAND

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SCENE AT ETAH, THE MOST NORTHERLY ESKIMO SETTLEMENT, SHOWING METHOD OF DRYING MEAT, OUT OF THE REACH OF DOGS AND POLAR BEARS

programme. I decided that I should strain every nerve to make five marches of twenty-five miles each, crowding these marches in such a way as to bring up to the end of the fifth long enough before noon to permit the immediate taking of an observation for latitude.

Weather and leads permitting, I believed I could do this. If my proposed distances were cut down by any chance, I had two means in reserve for making up the deficit.

First. To make the last march a forced one, stopping to make tea and rest the dogs, but not to sleep.

Second. At the end of the fifth march

to make a forced march with a light sledge, a double team of dogs, and one or two of the party, leaving the rest in camp.

Underlying all these calculations was a recognition of the ever-present neighborhood of open leads and impassable water, and the knowledge that a twenty-four hour gale would knock all my plans into a cocked hat, and even put us in imminent peril.

At a little after midnight of April 1, after a few hours of sound sleep, I hit the trail, leaving the others to break up camp and follow. As I climbed the pressure ridge back of our igloos, I set another hole in my belt, the third since I started. Every man and dog of us was lean and flat-bellied as a board, and as hard.

It was a fine morning. The wind of the last two days had subsided, and the going was the best and most equable of any I had yet. The floes were large and old, hard and clear, and were surrounded by pressure ridges, some of which were almost stupendous. The biggest of them, however, were easily negotiated, either through some crevice or up some huge brink.

I set a good pace for about ten hours. Twenty-five miles took me well beyond the 88th parallel. While I was building my igloos a long lead formed by the east and southeast of us at a distance of a few miles.

A few hours' sleep and we were on the trail again. As the going was now practically horizontal, we were unhampered and could travel as long as we pleased and sleep as little as we wished. The weather was fine and the going like that of the previous day, except at the beginning, when pickaxes were required. This and a brief stop at another lead cut down our distance. But we had made twenty miles in ten hours and were half way to the 89th parallel.

The ice was grinding audibly in every direction, but no motion was visible. Evidently it was settling back in equilibrium and probably sagging due northward with its release from the wind pressure.

Again there was a few hours' sleep, and we hit the trail before midnight. The weather and going were even better. The surface, except as interrupted by infrequent ridges, was as level as the glacial fringe from Hecla to Columbia and harder.

We marched something over ten hours, the dogs being often on the trot and made 20 miles. Near the end of the march, we rushed across a lead 100 yards wide, which buckled under our sledges, and finally broke as the last sledge left it.

We stopped in sight of the 89th parallel, in a temperature of 40 degrees below. Again a scant sleep, and we were on our way once more and across the 89th parallel.

This march duplicated the previous one as to weather and going. The last few hours it was on young ice, and occasionally the dogs were galloping. We made 25 miles or more, the air, the sky, and the bitter wind burning the face till it cracked. It was like the great interior ice cap of Greenland. Even the natives complained of the bitter air. It was as keen as frozen steel.

A little longer sleep than the previous ones had to be taken here as we were all in need of it. Then on again.

Up to this time, with each successive march, our fears of an impossible lead had increased. At every inequality of the ice, I found myself hurrying breathlessly forward, fearing that it marked a lead, and when I arrived at the summit would catch my breath with relief—only to find myself hurrying on in the same way at the next one. But on this march, by some strange shift and feeling, this fear fell from me completely. The weather was thick, but it gave me no uneasiness.

Before I turned in I took an observation, which indicated our position as 89.25. A dense, lifeless pall hung overhead. The horizon was black and the ice beneath was a ghastly, shelly-white, with no relief—a striking contrast to the glimmering, sunlit fields of it over which we had been traveling for the previous four days.

The going was even better and there was scarcely any snow on the hard, granular, last summer's surface of the old floes dotted with the sapphire ice of the previous summer's lakes.

A rise in temperature to 15 below reduced the friction of the sledges and gave the dogs the appearance of having caught the spirit of the party. The more sprightly ones, as they went along with tightly-curled tails, frequently tossed their heads, with short, sharp barks and yelps.

In twelve hours we made 40 miles. There was not a sign of a lead in the march.

I had now made my five marches, and was in time for a hasty noon observation through a temporary break in the clouds, which indicated our position as 89.57. I quote an entry from my journal some hours later:

"The pole at last! The prize of three centuries. My dream and goal for twenty years! Mine at last! I cannot bring myself to realize it. It all seems so simple and commonplace. As Bartlett said when turning back, when speaking of his being in these exclusive regions which no mortal has ever penetrated before, 'It's just like every day.'"

Of course I had my sensations that made sleep impossible for hours, despite my utter fatigue—the sensations of a lifetime; but I have no room for them here.

The first thirty hours at the pole were spent in taking observations; in going some ten miles beyond our camp, and some eight miles to the right of it; in taking photographs, planting my flags, depositing my records, studying the horizon with my telescope for possible land, and searching for a practicable place to make a sounding.

Ten hours after our arrival, the clouds cleared before a slight breeze from our left, and from that time until our departure in the afternoon of April 7, the weather was cloudless and flawless. The minimum temperature during the thirty hours was 33 below, the maximum 12.

We had reached the goal, but the return was still before us. It was essential that we reach the land before the next spring tide, and we must strain every nerve to do this.

I had a brief talk with my men. From now on, it was to be a big travel, little sleep, and a hustle every minute. We would try, I told them, to double march on the return—that is, to start and cover one of our northward marches, make tea and eat our luncheon in the igloos, then cover another march, eat and sleep a few hours, and repeat this daily.

As a matter of fact, we nearly did this, covering regularly on our return journey five outward marches in three return marches. Just as long as we could hold the trail we could double our speed, and we need waste no time in building new igloos.

Every day that we gained on the return lessened the chances of a gale destroying the track. Just above the 87th parallel was a region fifty miles wide, which caused me considerable uneasiness. Twelve hours of strong easterly, westerly or northerly wind would make this region an open sea.

In the afternoon of the 7th we started on our return, having double-fed the dogs, repaired the sledges for the last time, and discarded all our spare clothing to lighten the loads.

Five miles from the pole a narrow crack filled with recent ice, through which we were able to work a hole with a pick-axe, enabled me to make a sounding. All my wire, 1,500 fathoms, was sent down, but there was no bottom. In pulling up the wire parted a few fathoms from the surface, and lead and wire went to the bottom. Off went the reel and handle, lightening the sledges still further. We had no more use for them now.

Three marches brought us back to the igloos where the Captain turned back. The last march was in the wild sweep of a northerly gale, with drifting snow and the ice rocking under us as we dashed over it.

South of where Marvin had turned back we came to where his party had built several igloos while delayed by open

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AN ESKIMO, HIS WIFE, SONS, AND DAUGHTERS

leads. Still further south we found where the Captain had been held up by an open lead and obliged to camp. Fortunately, the movement of these leads was simply open and shut, and it took considerable water motion to fault the trail seriously.

While the Captain and Marvin, as was found out later, and Borup had been delayed by open leads, we seemed to bear a patent charm and at no single lead were we delayed more than a couple of hours. Sometimes the ice was fast and firm enough to carry us across; sometimes a short detour, sometimes a brief halt for the lead to close, sometimes an improvised ferry on an ice-cake, kept the trail without difficulty down to the tenth outward march.

Igloos there disappeared completely,

Photo and Copyright by Underwood & Underwood

AN ESKIMO MOTHER AND BABE

and the entire region was unrecognizable. Where on the outward journey had been narrow cracks, there were now broad leads, one of them over five miles in width, caught over with young ice.

Here again fortune favored us, and no pronounced movement of the ice having taken place since the Captain passed we had his trail to follow. We picked up the old trail again north of the seventh igloos, followed it beyond the fifth, and at the big lead lost it finally.

From here we followed the Captain's trail, and on April 23 our sledges passed up the vertical edge of the glacier fringe, a little west of Cape Columbia. When the last sledge came up I thought my Eskimos had gone crazy. They yelled and called and danced themselves helpless. As Ooath sat down on his sledge he remarked in Eskimo:

"The Devil is asleep or having trouble with his wife, or we never should have come back so easily."

A few hours later we arrived at Crane City under the bluffs of Cape Columbia, and after putting four pounds of pemmican into each of the faithful dogs to keep them quit, we had at last our chance to sleep. Never shall I forget that sleep at Cape Columbia. It was sleep, sleep, then turn over and sleep again. We slept gloriously, with never a thought of the morrow or of having to walk, and, too, with no thought that there was to be never a night more of blinding headache. Cold water to a parched throat is nothing compared with sleep to a numbed, fatigued brain and body.

Two days we spent here in sleeping and drying our clothes; then for the ship. Our dogs, like ourselves, had not been hungry when we arrived, but simply lifeless with fatigue. They were different animals, and the better ones among them stept on with tightly curled tails, uplifted heads, and their hind legs treading the snow with piston-like regularity. We reached Hecla in one march, and the *Roosevelt* in another.

When we got to the *Roosevelt,* I was staggered by the news of the fatal mishap to Marvin. He had either been less cautious or less fortunate than the rest of us, and his death emphasized the risk to which we had all been subjected, for there was not one of us but had been in the sledge during some time in the journey.

The big lead, cheated of its prey three years before, had at last gained its human victim.

The rest can be quickly told. McMillan and Borup had started for the Greenland coast to deposit caches for me. Before I arrived a flying Eskimo courier from me overtook them with instructions that the caches were no longer needed, and that they were to concentrate their energies on tidal observations, etc., at Cape Morris Jesup, and north from there.

These instructions were carried out, and after their return in latter part of May, McMillan made some further tidal observations at other points. The supplies remaining at the various caches were brought in, and on July 18 the *Roosevelt* left her winter quarters and was driven out into the channel pack of Cape Nion.

She fought her way south in the center of the channel, and passed Cape Sabine on August 8, or thirty-nine days earlier than in 1908, and thirty-two days earlier than the British expedition in 1876.

We picked up Whitney and his party and the stores at Etah. We killed 70 odd walrus for my Eskimos, whom I landed at their homes. We met the *Jeanie* off Saunders Island and took over her coal, and cleared from Cape York on August 26, one month earlier than in 1906.

On September 5 we arrived at Indian Harbor, whence the message, "Stars and Stripes nailed to North Pole," was sent vibrating southward through the crisp Labrador air.

The culmination of long experience, a thorough knowledge of the conditions of the problem, gained in the last expedition—these together with new sledges, which reduced the work of both dogs and driver, and a new type of camp cooker, which added to the comfort and increased the hours of sleep of the men's party, combined to make the present expedition an agreeable improvement on the last in respect to the rapidity and effectiveness of its work, and the lessened discomfort and strain upon the members of the party.

As to the personnel, I have again been particularly fortunate. Captain Bartlett is just Bartlett—tireless, sleepless, enthusiastic, whether on the bridge, or in

Photo and Copyright by Underwood & Underwood

CHILDREN OF THE TOP OF THE WORLD

Photo and Copyright by Underwood & Underwood

A STRIKING SCENE IN THE ARCTIC REGIONS: EXPLORERS' SHIPS, ICE BERGS, AND ICE FLOATS: VERY GOOD WHALE FISHING IS TO BE FOUND HERE, BAFFIN BAY

SCENE ON THE GREENLAND COAST Photo and Copyright by Underwood & Underwood

the crow's nest, or at the head of a sledge division in the field.

Dr Goodsell, the surgeon of the expedition, not only looked after its health and his own specialty of microscopes, but took his full share of the field work of the expedition as well, and was always ready for any work.

Profs. Marvin and McMillan have secured a mass of scientific data, having made all the tidal and most of the field work, and their services were invaluable in every way.

Borup not only made the record as to the distance traveled during the journey, but to his assistance and expert knowledge of photography is due what I believe to be the unequalled series of photographs taken by the expedition.

Henson in the field and Percy as steward, were the same as ever, invaluable in their respective lines. Chief Engineer Wardwell, also of the last expedition, aided by his assistant, Scott, kept the machinery up to a high state of efficiency and has given the *Roosevelt* the force and power which enabled her to negotiate apparently impracticable ice.

Mr Gushue, the mate, who was in charge of the *Roosevelt* during the absence of Captain Bartlett and myself, and Boatswain Murphy, who was put in charge of the station at Etah for the relief of Cook, were both trustworthy and reliable men, and I count myself fortunate in having had them in my service.

The members of the crew and the firemen were a distinct improvement over those of the last expedition. Every one of them was willing and anxious to be of service in every possible way. Connors, who was promoted to be boatswain in the absence of Murphy, proved to be particularly effective. Barnes, seaman, and Wiseman and Joyce, firemen, not only assisted Marvin and McMillan in their tidal meteorological observations on the *Roosevelt*, but Wiseman and Barnes went into the field with them on their trips to Cape Columbia, and Condon and Cody covered 1,000 miles hunting and sledging supplies.

As for my faithful Eskimos, I have left them with ample supplies of dark, rich walrus meat and blubber for their winter, with currants, sugar, biscuits, guns, rifles, ammunition, knives, hatchets, traps, etc., and for the splendid four who stood beside me at the pole a boat and tent each to requite them for their energy, and the hardships and toil they underwent to help their friend Peary to the North Pole.

But all of this—the dearly bought years of experience, the magnificent strength of the *Roosevelt*, the splendid energy and enthusiasm of my party, the loyal faithfulness of my Eskimos—would have gone for naught but for the faithful necessaries of war furnished so loyally by the members of the Peary Arctic Club. And it is no detraction from the living to say that to no single individual has the fine result been more signally due than to my friend the late Morris K. Jesup, the first President of the Club.

Their assistance has enabled me to tell the last of the great earth stories, the story the world has been waiting to hear for 300 years—the story of the discovery of the North Pole.

NORTH POLAR MAP

READERS of this Magazine interested in Polar exploration are reminded of the map of the Arctic regions compiled by Gilbert H. Grosvenor and published as a supplement to our July, 1907, Arctic number. The map shows the routes of the principal North Polar explorers, and gives much historical as well as geographical information. The map is 24 x 24 inches, and in nine colors, the color of the land showing the nationality of the pioneer explorer. Copies of the map may be obtained from the National Geographic Society at 25 cents each; backed with linen, 50 cents.

To Dr Theodore Le Boutillier, Secretary of the Geographical Society of Philadelphia, the NATIONAL GEOGRAPHIC MAGAZINE is indebted for the interesting views of Greenland printed on pages 877 to 891 of this number. The illustrations are from a collection of photographs made by Dr Le Boutillier during several months spent in the Arctic regions some years ago as a member of one of Commander Peary's expeditions.

MAP OF NORTH POLAR REGIONS

FISHING AND HUNTING TALES FROM BRAZIL

By Dewey Austin Cobb

BRAZIL is certainly the lazy fisherman's paradise. In common with many readers and travelers, I had heard a great deal about a way the natives of tropical America have of catching fish with poison which does not unfit them for food. It is one of the things that they do not explain to strangers, however, perhaps because it is forbidden by law to use this method in the streams, and partly because the Tupuya Indians, among whom it is chiefly practiced, seldom tell white folks anything useful if they can help it; consequently it was only after two years' residence among this secretive people that I was reluctantly taken into their confidence sufficiently to be permitted to join them on one of their fishing excursions.

Just as we were sitting down to dinner one day, a party of Indians, men, women, and children, straggled up to the house, every one carrying a bag or basket, in which some part of a week's outfit for camping in the woods was contained. They had walked out that morning from Santarem, seven miles distant, and were going to spend a week in fishing on the stream which operated my friends' sawmill. Every caller expects and gets a lunch among these people, and my host fed them according to custom.

After some hesitation they consented to let me join them. We followed the stream for half a mile or so, to where it spread out into a pool, perhaps fifty feet across; there they hung their hammocks and built a fire. The men then divided into two parties, one going up and the other down the stream a few rods, then, stripping to the skin, entered the stream, and, thrashing the water with their feet and with sticks, returned to the pool driving all the fish before them to the pool. One man remained at the outlet and one at the inlet, while the others dressed and climbed out.

Meantime one of the women had taken from one of their bags the dried tongue of a pira-rucu (red fish), which serves almost universally as the family grater for both whites and Indians, being thickly covered with minute, horny spines, turned backward to enable the fish to hold its prey. From another bag she produced the mysterious "barbasco" roots, which resembled rather stocky horseradish roots, and grated them into about two quarts of water.

This mixture was thrown by dipperfuls into the pool at various points; then we all sat down to await results. In about two minutes we began to see minute fish come to the surface, belly up, remain a few seconds, then with a flirt disappear, to return again a moment later and remain longer. At the end of ten minutes all the small fry in the pond were on the surface, apparently dead, while larger and larger ones began to go through the same performance.

After watching this fantastic performance for twenty minutes or so our leader rigged a long-handled scoop-net, and fishing began. By this time fish from eight to twelve inches long remained on the surface long enough to be easily captured with the net and were put in a bushel basket, which was nearly filled in half an hour. There were half a dozen varieties, but the greater part were a species of catfish. A few resembled bass, but were much lighter in color. Most of them were entirely new to northern eyes.

After some of them were broiled, the man who seemed to direct operations, noticing that I did not join in the feast and surmising the reason, took several spoonfuls of the poisoned water and, mixing it with a dipperful of water, drank it down. It had not the slightest effect upon him, and, fully reassured, I ate the fish heartily with the rest, and never did I enjoy broiled fish more.

When our feast was finished I strolled down the stream to see how the fish were affected below the pool. Many of the very smallest of them floated by, apparently dead, and I was told that they would not recover, but make food for the larger ones, who were not affected by eating them. To all appearance they were affected only through their respiratory organs, and experience no lasting injury. With the exception of an occasional flash of white belly, which disappeared as quickly as it came in sight, the larger fish, such as we had taken out, when they had reached the diluted poison of the stream below, were not at all affected.

After we all, men, women, and children, had smoked one of their cigarettes, rolled in pungent cascara bark instead of paper, I went home alone, less mystified by the barbasco fishing than by the inherited capacity of this ancient race, to enjoy a whole week, with nothing to think about, and nothing to do, but eat, sleep, and smoke.

HOW THE UNTUTORED SAVAGES KEPT A TRIBE-SECRET 400 YEARS

"Urari (or Curari) is the most powerful sedative in nature; tipped with it, the needle-like arrows used by the Indians of the upper Amazon, in their blow-guns, will kill an ox in twenty minutes and a monkey in ten."

This is substantially the statement made by Prof. James Orton, A. M., in his volume "The Andes and the Amazons." The fact that the secret of compounding this unique poison has been kept so long from its numberless seekers is perhaps the strangest thing about it.

The first mention of it made to the civilized world was by Orellana in his account of his descent of the "Great River" when he deserted, with a portion of the men, from the conquering army of Francisco Pizarro and sailed down to the Atlantic Ocean in 1539. He wrote that his company was "fired upon by the hostile Indians with minute, poisoned arrows." This is the same trip when he reported that he was attacked by a band of savage female warriors with bows and arrows. His report of the poisoned arrows has been verified by later travelers, although the "female warriors," from whom the mighty river derived its name, proved to be a shiftless tribe of savages, too lazy to make other garments, who wore in the place of clothes a sheet of thin bark with a hole in the middle to slip over the head, after which it was belted at the waist, and was easily mistaken for a woman's dress. The same costume is still worn by them.

The great traveler and naturalist, Baron Von Humboldt, in 1803, was the first to bring to Europe a sufficient quantity of the poison for analysis. It was found to contain a hitherto unknown alkaloid, which was named *curarine*.

Urari is prepared by only a few tribes of savages on the upper waters of the Amazon and Orinoco rivers, where it is almost the only article made for sale. It is sold mostly to other tribes, who use it for killing birds whose plumage has been in great demand in late years among the river traders.

The price of urari, where it is made, is quite uniformly its weight in silver. In Quito, where considerable is marketed, a one-half gill cup of it costs $1.50.

The gun in which these poisoned arrows are used consists of a straight bamboo tube, from five to six feet long, with a sight on one end and a funnel-shaped expansion to fit the mouth at the other. The principle is precisely the same as a schoolboy's tube for blowing putty-balls, but the bore is so large, about one-half inch, that it requires more breath than untrained lungs can supply to make it effective. Even the most expert can shoot only a short distance, as compared with firearms, but their accuracy is wonderful when one considers the difficulty of sighting a tube from the position in which it is held.

The arrows consist of a point of wood or bone, not more than an inch long, and the size of a toothpick, to which is attached a little tuft of the airy fiber of the silk cotton tree, which is as light as thistle-down, and will not "pack" like

cotton fiber, and so lose the necessary symmetry of form to insure accuracy. The point is then dipped in a thick solution of the poison, dried, and is ready for use.

These arrows have not the geometrical trajectory of the bullet or common arrow. Owing to their lightness they travel in an almost horizontal line until the air's resistance stops them, when they drop almost straight to the ground.

Ever since the unique qualities of urari became known, great interest has been taken and many efforts made to learn the secret of compounding it. Humboldt learned that one plant was always an important ingredient; this is the vine, *Strychnos toxifera,* which, however, contains no trace of strychnine, but is very poisonous. It must be used in combination with other plants to produce the characteristic effects of urari.

In 1872 one additional ingredient was learned by Prof. Orton, who wrote, "Tobacco and the milk of another plant is added, coagulating it." Without this "milk of another plant," it is not the preëminent sedative which the medical world seeks—one which produces death, indistinguishable from sleep, in its approach.

A few weeks before my return home from Brazil, a gentleman left the steamer on its downward trip and came for two weeks' rest to the plantation where I was visiting, before taking the sea voyage home. He was a professor in a German university, he told us, and had spent two years 1,000 miles further up the Amazon, among the Ticuna Indians, and was now on his way back. He was thin and sallow, and seemed to need rest. A few days before his departure I questioned him about the purpose of such an unusual proceeding, and he related the following experience:

"The medical faculty of our university has been experimenting for several years with urari, and believed they were on the eve of finding a way of using the tremendous potentiality of this unique poison to good account in treating some nervous diseases when our supply became exhausted.

"After thoroughly satisfying ourselves that some vital element was unknown to the travelers who believed they had learned the secret, and had given us their preparations to test, the university decided to send a botanist, who was also a physician, among the Indians who had made our best samples, and who was to remain long enough to secure their carefully guarded secret. I was the one chosen and equipped for this service, and started immediately.

"It was six months before I could get to work. I had to find a village where they made it, learn a little of their inhuman language, and win their confidence enough to be received among them without exciting their suspicions of my object in coming, for their secret had often been sought by visitors, and they were very suspicious.

"When one day it was announced that urari was to be made, I joined one of the parties sent out to gather the vine, *Strychnos toxifera,* which I already knew, having seen it in some European botanical gardens, cultivated as a curiosity. This was cut in suitable lengths and thrown into a kettle of water, which was kept boiling three days, adding more, and throwing away the old, after it had cooked six hours.

"The third night, when the vine had all been used, the refuse was thrown away, and some hoodoo ceremonies and incantations were performed by the leaders, as they marched around the kettle.

"I think I should say here that from first to last three old men directed everything, and I believe that other members of the tribe knew as little about making urari as I did. They seemed, however, to be greatly impressed by the ceremonies.

"The next day only six people were sent to the woods, each to gather some one plant. I had no trouble in identifying all these before they were put into the kettle of boiling water, left after the vines had been thrown away, and I was encouraged.

"The following day nearly the whole tribe went out in small parties for the final gathering. When they came in at midday, each brought a bundle of plants

containing many varieties, which were thrown down in a pile beside the kettle. It would have taken the best botanist a week to identify them all, even if there had not been some of them that were unknown and unnamed by botanists.

"That evening a short ceremony was performed, in which the great medicine spirit was asked to show them which of these were to be used. Then all three began to pick them up, one by one. Nearly all were thrown away, and the few chosen were hastily tossed into the pot, and lost sight of in the cloud of evil-smelling steam that rose above it. So many kinds of leaves of tropical plants exude a "white, milky sap" that I saw at once that I was defeated in my quest, at least in that settlement.

"However, I went down the river to another village where urari was made, but only stayed long enough to learn that similar tactics were used for guarding the secret.

"I realized that I was beaten. My health had suffered by exposure and unaccustomed food, and I started home, after buying, for its weight in silver, all the poison that they had ready for market."

A short time previous to the arrival of the professor an Indian had drifted down the river in search of work. He had brought with him a blow-gun and some arrows, not yet poisoned, which he had sold to me as curiosities. He had had some experience in using the gun, but did not claim to be skillful in its use. At my request the professor consented to dip some of my arrows in urari, as he had seen the Indians do it, and next morning at daylight go to a distant cornfield, where deer came at night to feed and paw in the soft earth, leaving it at or before sunrise.

Next morning at dawn we were carefully hidden on the leeward side of the field, to prevent their getting "our wind," in one of the little arched openings where all wild creatures pass the hedge-like border of the clearing. Here we lay flat on the ground so that we could see into the growing corn.

Our presence was evidently unsuspected, for we had waited but a few minutes when we heard some creature rustling the corn leaves. A moment later a good-sized buck walked leisurely out of the corn and stopped and partly turned to look back, just as it reached the mouth of our "tunnel," thus exposing to us its full broadside as we lay some thirty feet away.

After a deliberate aim our hunter fired, if I may use such a word for the little puff, scarcely heard by us, and entirely inaudible above the rustling corn leaves at the distance of the deer.

The animal gave a slight start as he felt the prick of the arrow on his flank, and turned partly round, sniffing the air for a scent, and looking about as if searching for the insect that had bitten or stung him. Detecting nothing, he stood still and unalarmed. At the end of a minute, or a minute and a half at most, his head drooped a little, as if he was sleepy.

When the hunter saw this he rose and stepped out in plain sight. The deer turned his head and looked at him, and moved forward, not away from him, a few steps and stopped. He showed no fear, but simply curiosity. After another minute the professor and I rose, and all three walked quietly to within reach of him.

He made no movement to run away, but watched us intently, and shifted his position a little. His movements seemed perfectly easy and natural. Absence of fear was the only observable change, until at the end of three minutes more; then it laid down, not falling, but as naturally as a cow or sheep when ready for sleep.

We all approached to its side, and the hunter laid a hand on its shoulder. It looked up at him, but showed no resentment nor fear. Even its breathing seemed easy and natural, which surprised me, as I had heard that death resulted from paralysis of the lungs when caused by urari. At the end of ten minutes, though it opened its eyes when touched, its breath became shorter and slower.

Eighteen minutes after it was struck by the arrow it was dead.

VOL. XX, No. 11 WASHINGTON NOVEMBER, 1909

THE NATIONAL GEOGRAPHIC MAGAZINE

THE NORTH POLE

AT a meeting of the Board of Managers of the National Geographic Society, Wednesday morning, October 20, the records and observations and proof of Commander Robert E. Peary that he reached the pole April 6, 1909, were submitted to the Society. The only question now to be decided by the association is whether or not Commander Peary reached the pole on this date, as claimed.

The records and observations were immediately referred to the Committee on Research, with the direction that the Chairman appoint a sub-committee of experts, of which he shall be a member, to examine said records and report on them to the Board. Mr Henry Gannett, Chairman of the Committee on Research, immediately appointed as the other members of the Committee Rear Admiral Colby M. Chester, U. S. Navy, and O. H. Tittmann, Superintendent of the U. S. Coast and Geodetic Survey.

This Committee of the Society will personally examine the note-books and original observations made by Commander Peary in his march to the pole, and see all the papers as brought back from the field. The Committee will report to the Board the result of its findings at a special meeting of the Board to be called for that purpose.

This action of the Society was taken in accordance with the by-laws of the Society, which provide that "The Committee on Research shall be charged with the consideration of all matters of scientific and technical geography, including exploration, which may be brought before the Society, or which may originate in the Committee; and shall report thereon to the Board of Managers, with recommendations for action."

At a meeting on October 1, the Board of Managers stated that the National Geographic Society could accept the personal statements of neither Commander Peary nor Dr Cook that the pole had been reached, without investigation by its Committee on Research or by a scientific body acceptable to it.

At the same meeting Commander Peary and Dr Cook were urged speedily to submit their observations to a competent scientific commission in the United States.

At a later meeting the Board joined in a request from the American Museum of Natural History, New York, and the American Geographical Society to President Ira Remsen that he, as the President of the National Academy of Sciences, appoint a commission to pass upon the records of Commander Peary and Dr Cook. This plan for an early examination failed, as Dr Remsen stated that he would not be able to appoint said commission unless authorized by his Council, which meets late in November, and unless also requested to do so by both Commander Peary and Dr Cook.

Commander Peary was willing to abide by such a commission, but Dr Cook stated that his observations would go first to the University of Copenhagen. In view of

the fact that Commander Peary had been waiting since his return to submit his records to a scientific commission in the United States, the National Geographic Society believed it should receive his papers now in order that his claim of having reached the pole may be passed upon without further delay.

The Society is ready to make a similar examination of Dr Cook's original observations and field notes, but as he promised to send them to the University of Copenhagen, and the Society will not have an opportunity of seeing them for probably some months, it did not seem fair to defer action on Commander Peary's observations until Dr Cook's papers were received by the Society. The only question now to be decided by the Society is whether or not Commander Peary reached the pole on April 6, 1909.

The following cablegram has been received by the Society from the University of Copenhagen, in reply to the Society's request that the University of Copenhagen waive its first claim to Dr Cook's records, in order that the records might be immediately examined in the United States and considerable delay avoided:

"OCTOBER 20, 1909.
NATIONAL GEOGRAPHIC SOCIETY,
WASHINGTON.

University regrets not able comply with your request.

TORP, *Rektor.*"

Mr Henry Gannett, Chairman of the Committee which will report on Commander Peary's observations, has been Chief Geographer of the U. S. Geological Survey since 1882; he is the author of "Manual of Topographic Surveying," "Statistical Atlases of the Tenth and Eleventh Censuses," "Dictionary of Altitudes," "Magnetic Declination in the United States," Stanford's "Compendium of Geography," and of many government reports. Mr Gannett is Vice-President of the National Geographic Society, and was one of the founders of the Society, in 1888.

Rear Admiral Colby M. Chester, U. S. Navy, was graduated from the U. S. Naval Academy in 1863. He has held practically every important command under the Navy Department, including Superintendent of the U. S. Naval Observatory, Commander-in-Chief Atlantic Squadron, Superintendent of the U. S. Naval Academy, Chief of Hydrographic Division, U. S. Navy. Admiral Chester has been known for many years as one of the best and most particular navigators in the service.

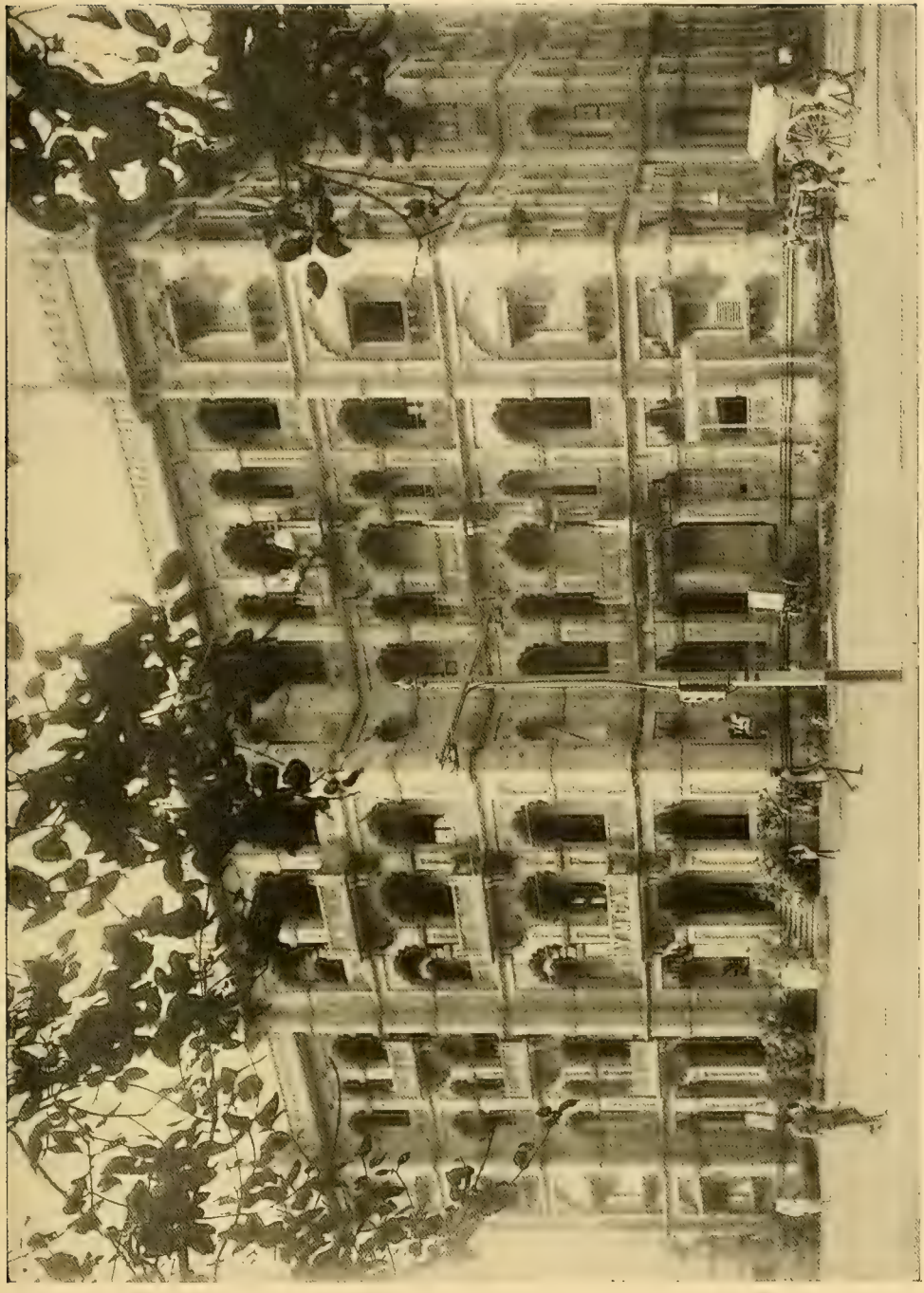
O. H. Tittmann has been Superintendent of the U. S. Coast and Geodetic Survey since 1900. He is the member for the United States of the Alaskan Boundary Commission, and was one of the founders of the National Geographic Society.

THE TEMPLES OF INDIA

FROM PHOTOGRAPHS BY W. M. ZUMBRO

THE home of the Y. M. C. A. in Bombay (picture number 1) is one of the many splendid buildings in that city of magnificent European structures, an adaptation of Indo-Saracenic to modern municipal architecture. Its size shows the scale on which the work is carried on and the support it has in the western capital and metropolis of India.

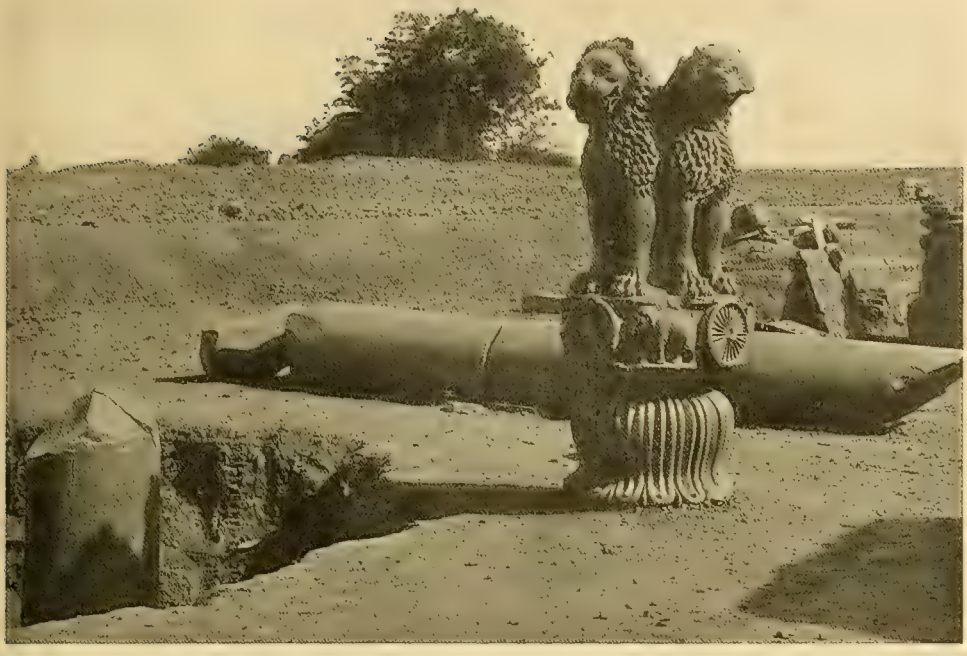
2. Nasick, mentioned by Ptolemy, is one of the sacred centers of India, situated on the banks of the sacred river, the Godavari, which is there bordered with temples and terraced stairways, as at Benares, and where also the pilgrims bathe by tens of thousands at every sunrise. Its ghati, or stairways, are always picturesque with Hindus from every part of the peninsula—priests, nobles, fakirs, and beggars. A large Christian mission station is appropriately placed in its suburbs.



I. THE Y. M. C. A. BUILDING IN BOMBAY

2. BOYS BEGGING AT NASICK

3. PILGRIMS BATHING IN THE SURF AT PURI



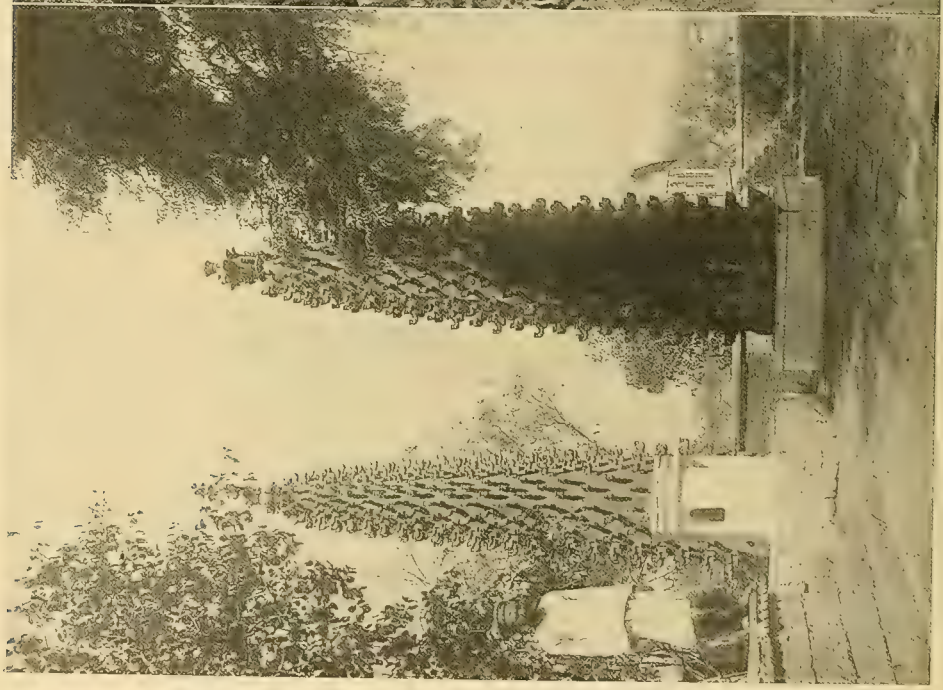
4. BROKEN PILLAR AND CAPITAL FROM SARANATH. THE BELL-SHAPED CAPITAL IS OF SYRIAN ORIGIN

5. THE MUSIC HALL AT DELHI

6. THE GREAT TEMPLE AT BUDDHA GAYA

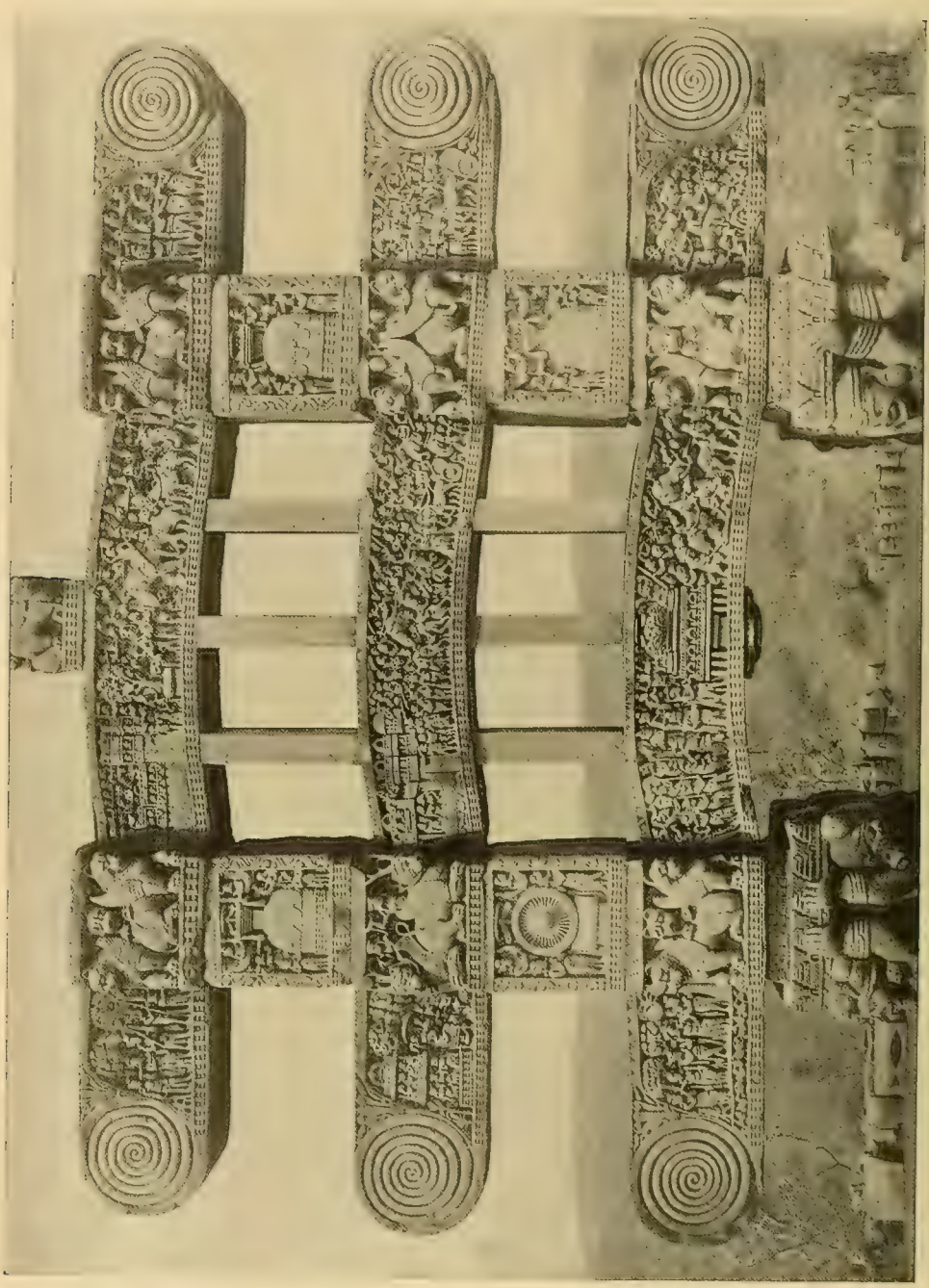
7. A PART OF THE BUDDHIST RAILING FROM THE TOPE AT BHARHUT, NOW IN THE CALCUTTA MUSEUM

9. FIGURES CARVED ON THE ROCK-CUT TEMPLES AT UJJAIN



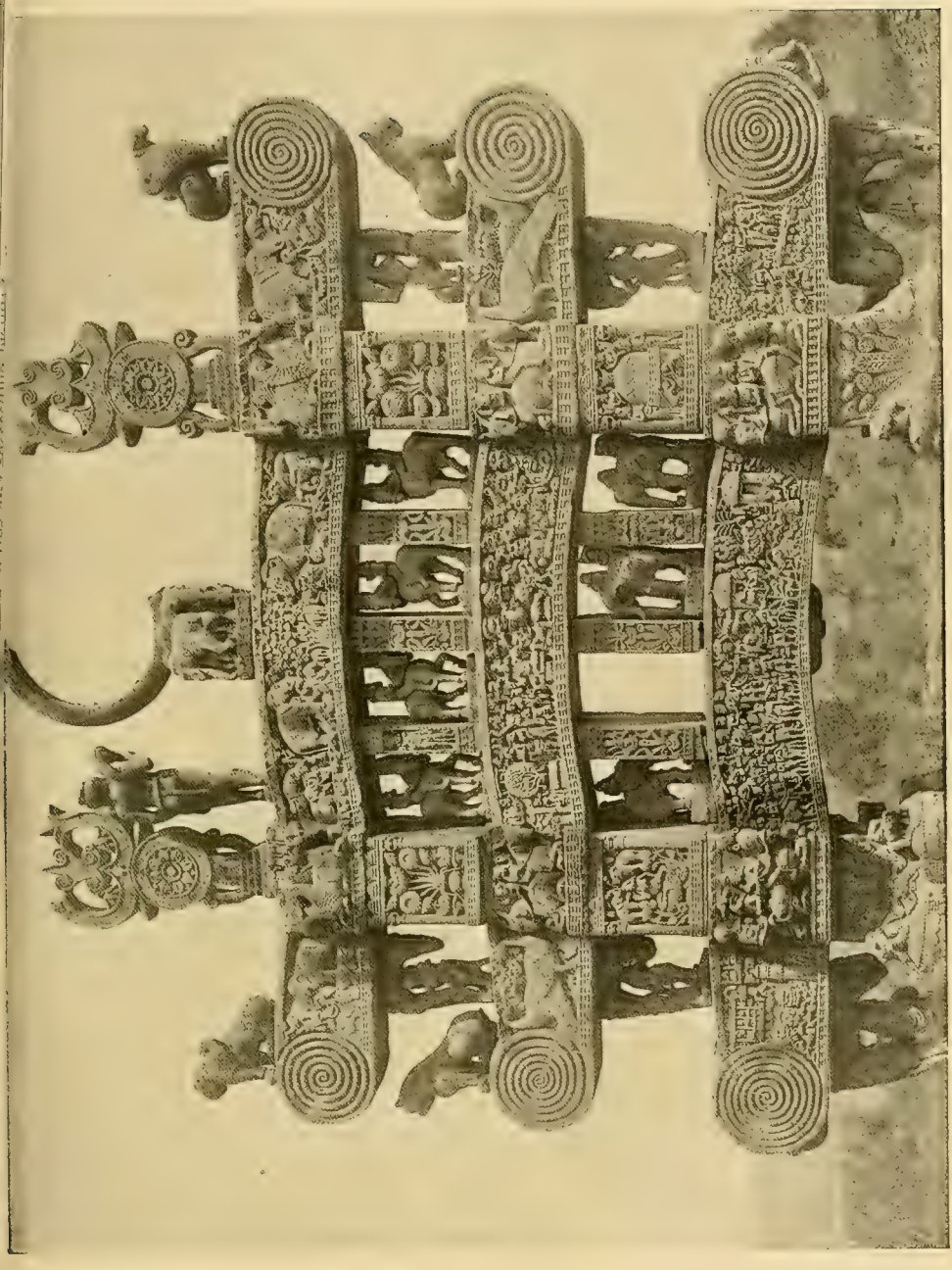
8. PILLARS ON WHICH LIGHTS ARE PLACED, UJJAIN

IO. GATEWAY TO THE TOPE AT SANCHI

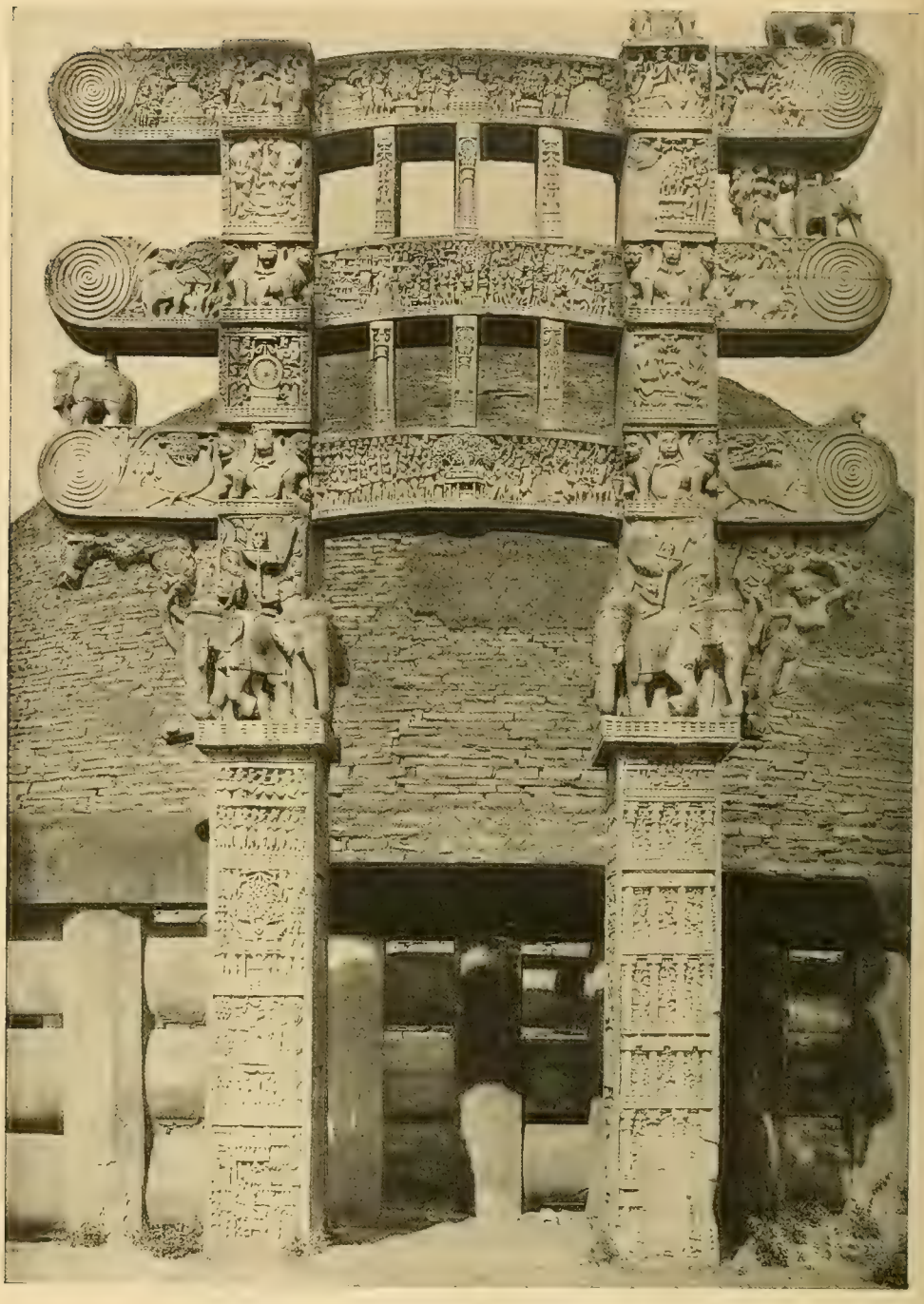


11. INNER SIDE OF THE WEST TORAN OR GATEWAY TO THE GREAT BUDDHIST TEMPLE AT SANCHI

Note the multitudes of diverse figures in this and succeeding pictures

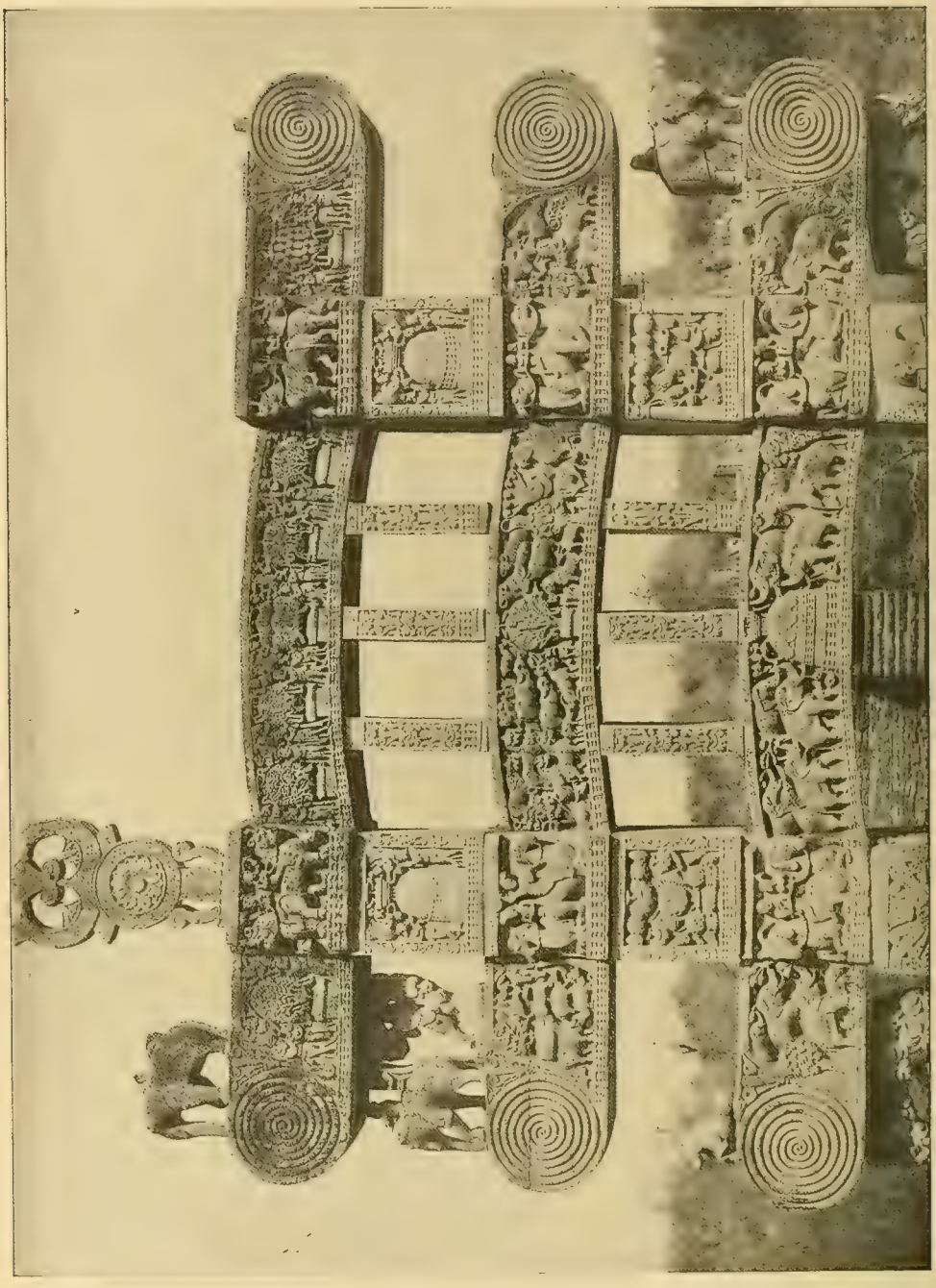


12. INSIDE OF THE NORTHERN TORAN OR GATEWAY TO THE TOPE AT SANCHI



13. OUTER SIDE OF THE EAST GATEWAY AT SANCHI

14. INNER SIDE OF THE LEFT PILLAR OF THE GATEWAY SHOWN ON PRECEDING PICTURE



15. INSIDE OF THE EAST TORAN OR GATEWAY OF THE BUDDHIST TOPE AT SANCHI (SHOWN ON

3. When the Jagannath festival is concluded all the pilgrims repair to the seashore, and the surf effectually washes away all sins.

4. Sarnath, once a great religious suburb of Benares, is now but a flat plain whose fields are mantled with ruins. It was the site of the Deer Park, where Gautama Buddha established himself and preached for forty rainy seasons, eventually overthrowing Brahmanism on its most sacred spot. The great tope, or memorial mound, covered with carvings and statues, was described by Fa Hian, the Chinese pilgrim, in 209 A. D., and by Hionen Thsang in 629 A D., and from their minute description the Anglo-Indian archeologists have been able to trace all those splendid edifices that filled the great walled enclosures of this famous Buddhist monastery.

5. The Nakar Khana, or Music Hall, in the fort at Delhi, stands opposite the magnificent red sandstone Lahore gate, admitting one to the great enclosure of the Mogul Emperor. One passes through the Nakar Khana to a second court to the great hall of public audience, with its jeweled inlaid throne. The music hall of red sandstone, inlaid with white marble and finished with rows of bell cupolas, held the trumpeters and musicians who welcomed and announced arrivals for great ceremonies.

6 The Great Temple of Maha Bodhi at Buddha Gaya, within one hundred miles of Benares, is the most sacred shrine of the Buddhist faith. This present temple succeeds earlier buildings, and is itself a seventh century construction. The tree at the right foreground is the Sacred Bo Tree, lineal descendant of the very same Bo Tree and occupying the same spot as the tree under which Gautama Buddha sat while he attained enlightenment. Archeology has brought to light and rescued a whole treasure-house of sculptured relics, some of which are cared for in a building beside the temple court. The original stone railing erected by Emperor Asoka around the early temple has been uncovered, and this "earliest sculptured monument in India" was precursor of the sculptured rails at other Buddhist shrines.

7. The sculptured railing from Bharahut, near Bhilsa, is now reërected in the Calcutta Museum, and all have opportunity to study there this wonderfully elaborate carving dating from the second century B. C. The figures illustrate scenes from the Jataka Stories.

8. Ujjain was the capital where Asoka ruled during his father's lifetime, and where later Vikramaditya ruled after he had driven the Scythians out of all northern India. He made it a center of Hindu learning and literature. The remains of the temples, after suffering at the hands of Mohammedan conquerors, show how splendid those structures were in Ujjain's prime. Number 8 shows the columns of light for festival times, when the pillars blaze from top to bottom with tiny flames.

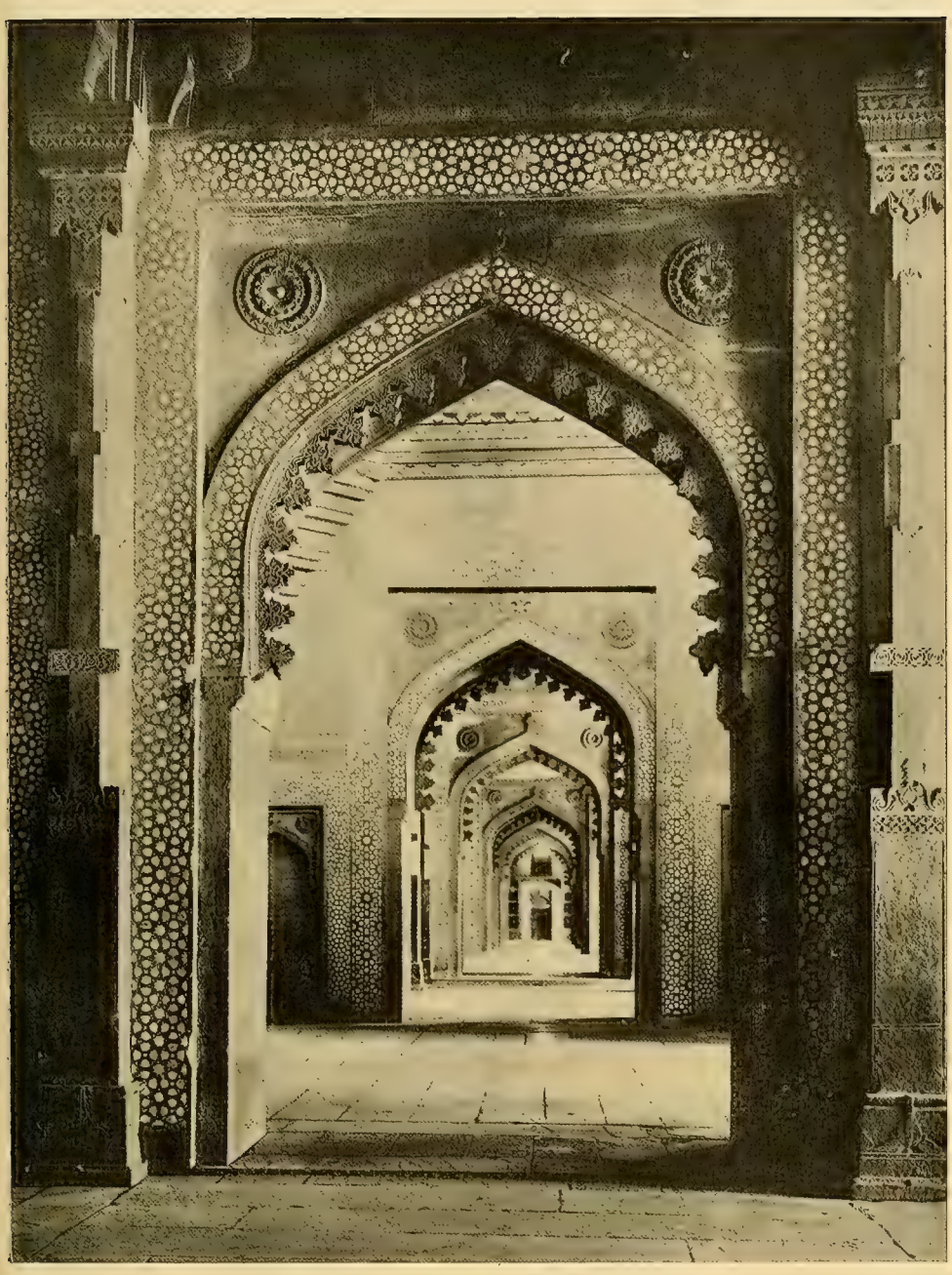
9. Fragments of sculptured columns and figures in the rock-cut temples at Ujjain, dating from Buddhist times.

10. Exterior of Toran, or gateway in the stone rail surrounding the tope at Sanchi. The great Buddhist tope or stupa at Sanchi, or memorial mound covering relics of the Buddha, is one of the most striking relics of the great religion now remaining. The mound, 106 feet in diameter and 46 feet in height, was once entirely faced with sculptured stones. The rail was pierced by four gateways, the monumental torans a mass of wonderful carving, unequaled by anything of later date in India. This tope is believed to have been erected two centuries before Christ, its carved rail and Torans probably later. Three of the gateways remain in place, and the great stupa has been given every care by Indian archeologists. The Torans which had fallen have been set up and carefully pieced together, and one has been reërected in Calcutta, casts of which are now to be seen at the British Museum, London, and at the Musée Guimet in Paris.

11. Inner side of the west gateway of the great Buddhist tope at Sanchi. The carving is in white sandstone, and prob-

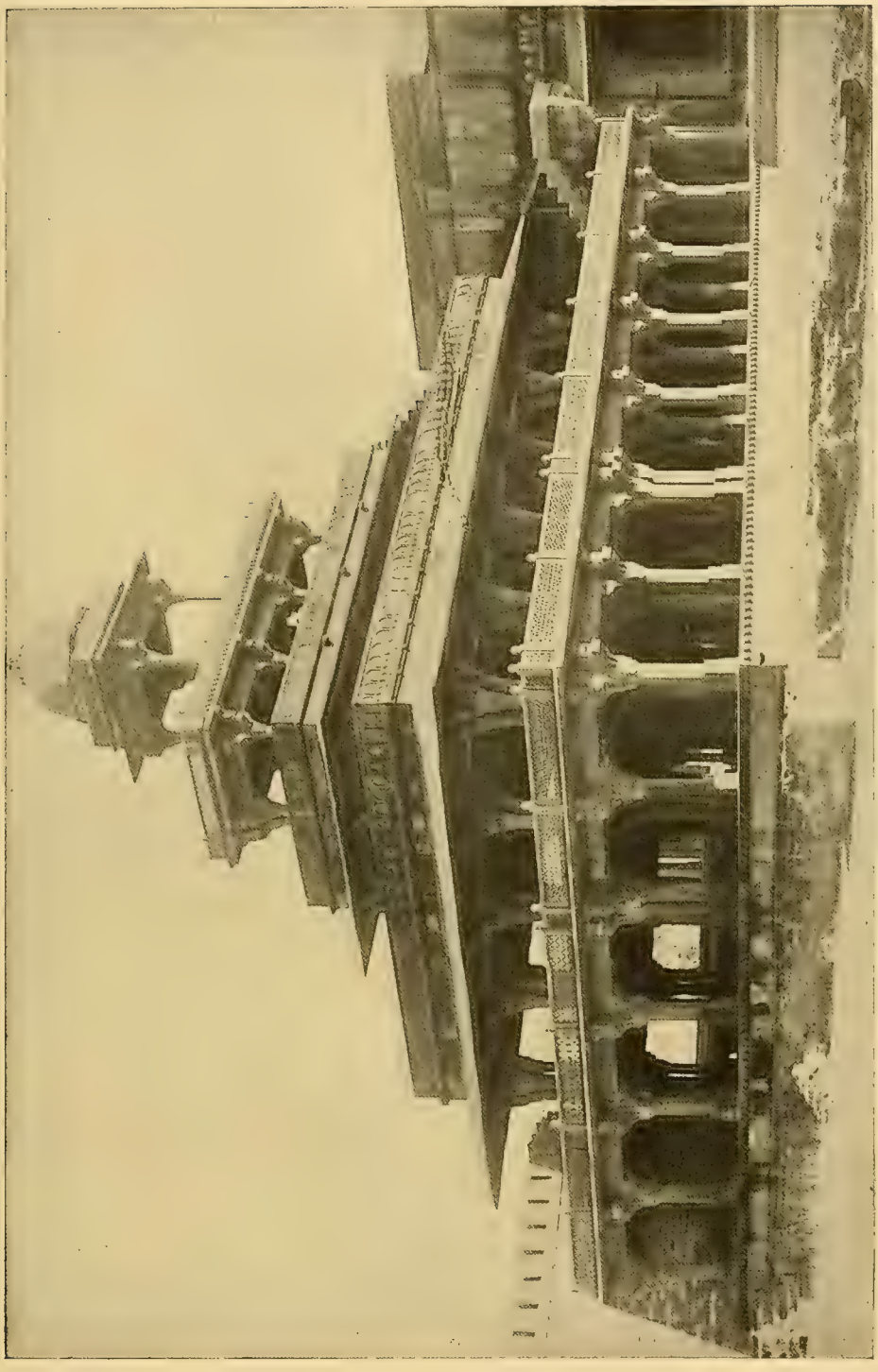
16. THE OBSERVATORY AT DELHI

17. THE BATH TUB OF THE EMPEROR JEHANGIR

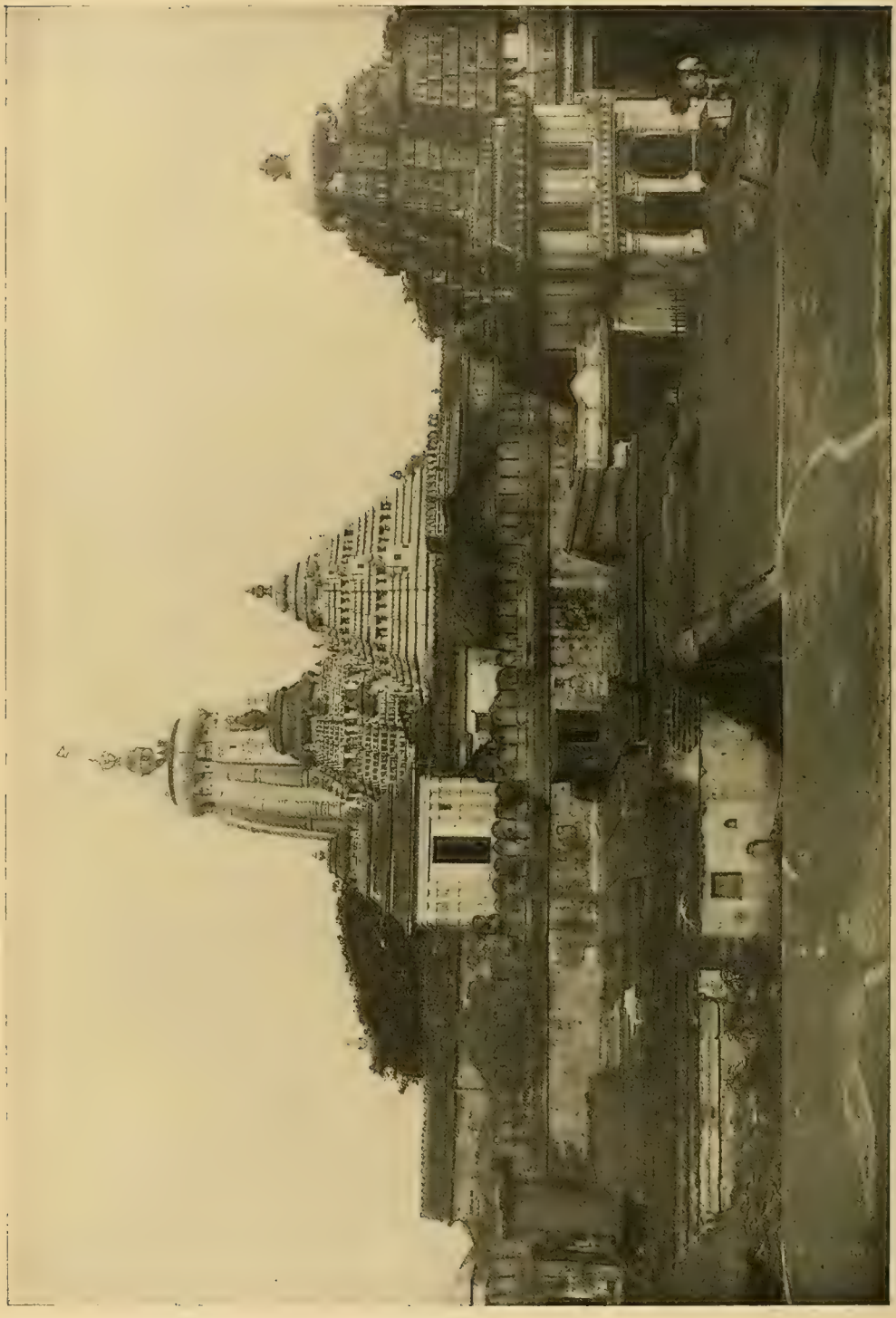


18. THE ARCHED DOORWAYS, INLAID WITH MOSAIC, OF THE MOSQUE AT FATEH PUR SIKRI

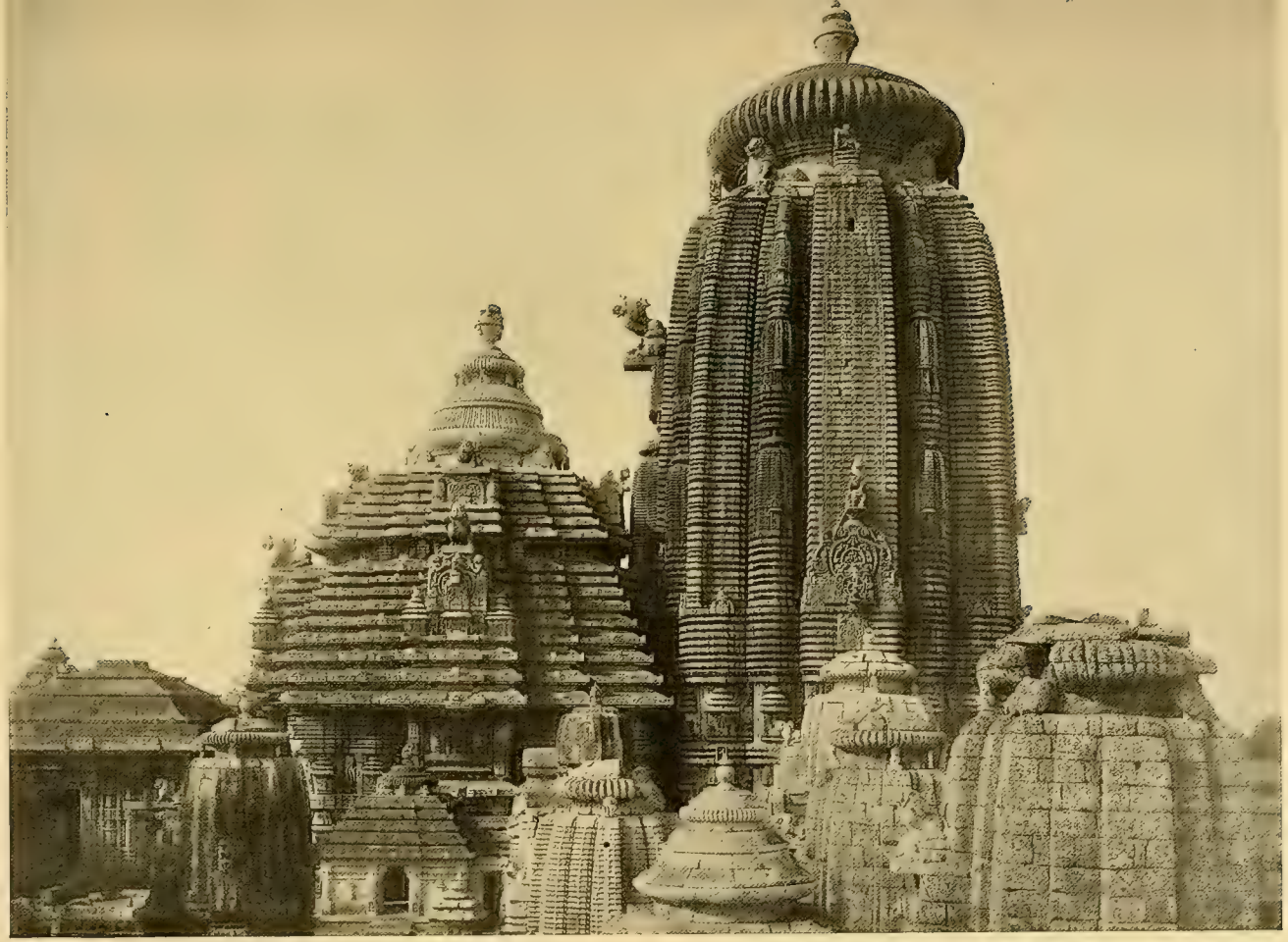
19. TOMB OF TAGLAKSHA AT TAGLAKSHABOD, DELHI



20. THE FIVE-STORIED PAVILION OR SUMMER PALACE OF THE EMPEROR AKBAR

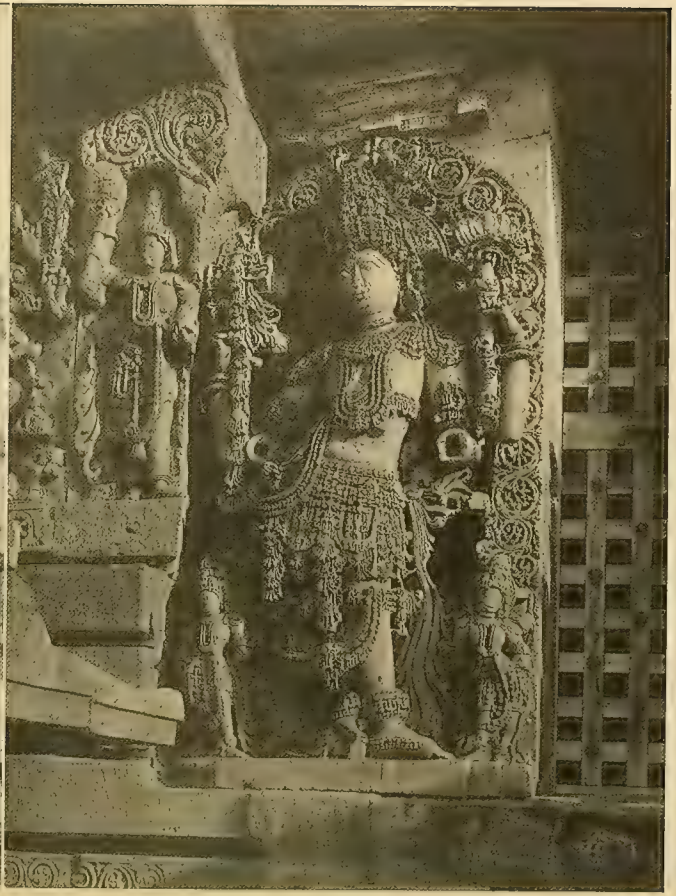


21. THE MOST FAMOUS TEMPLE OF INDIA, THE JAGANNATH AT PURI



22. THE GREAT TEMPLE AT BHUVANESHWAR: EVERY INCH OF THE SURFACE OF THE GREAT TOWER IS COVERED WITH INTRICATE CARVING

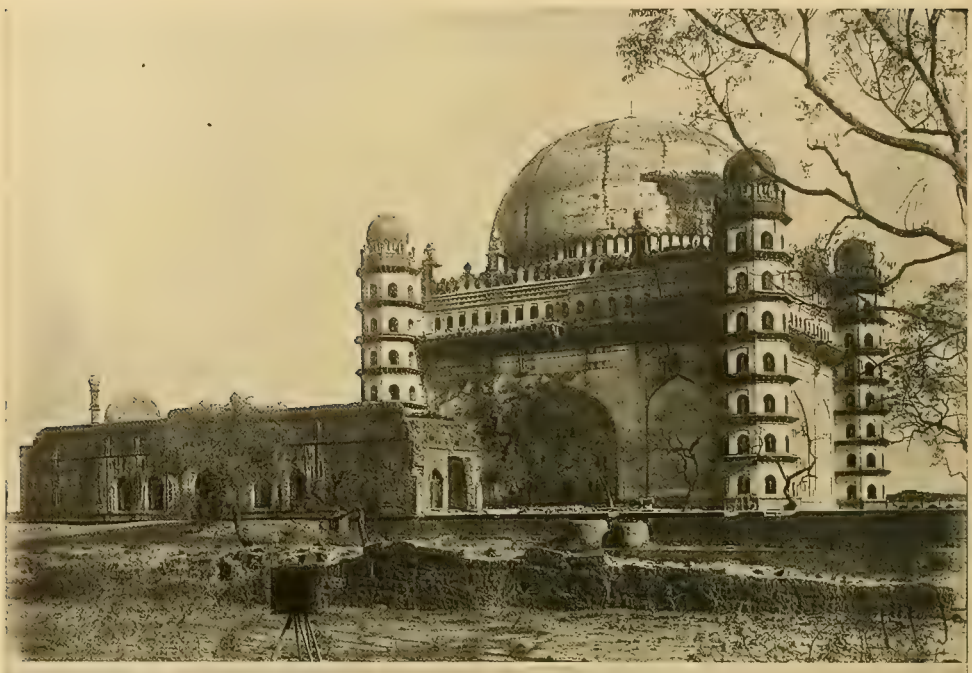
23. ARCH TO THE ENTRANCE OF THE GREAT TEMPLE SHOWN IN NUMBERS 22 AND 24

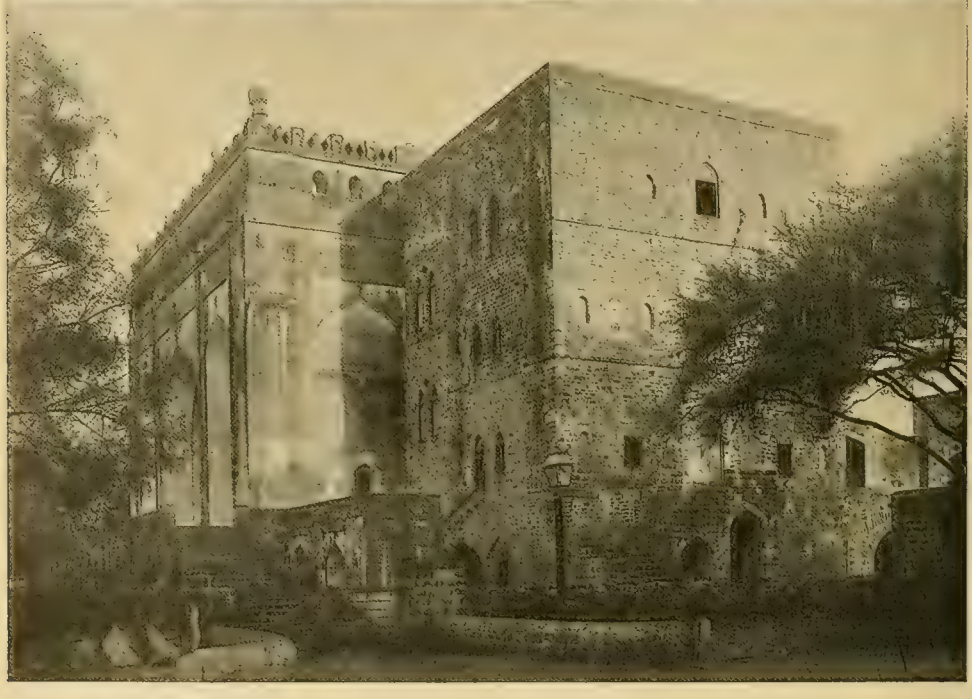


24. A WATCHMAN: TEMPLE AT BELUR

25. THE FAMOUS ROCK OF TRICHINOPLY

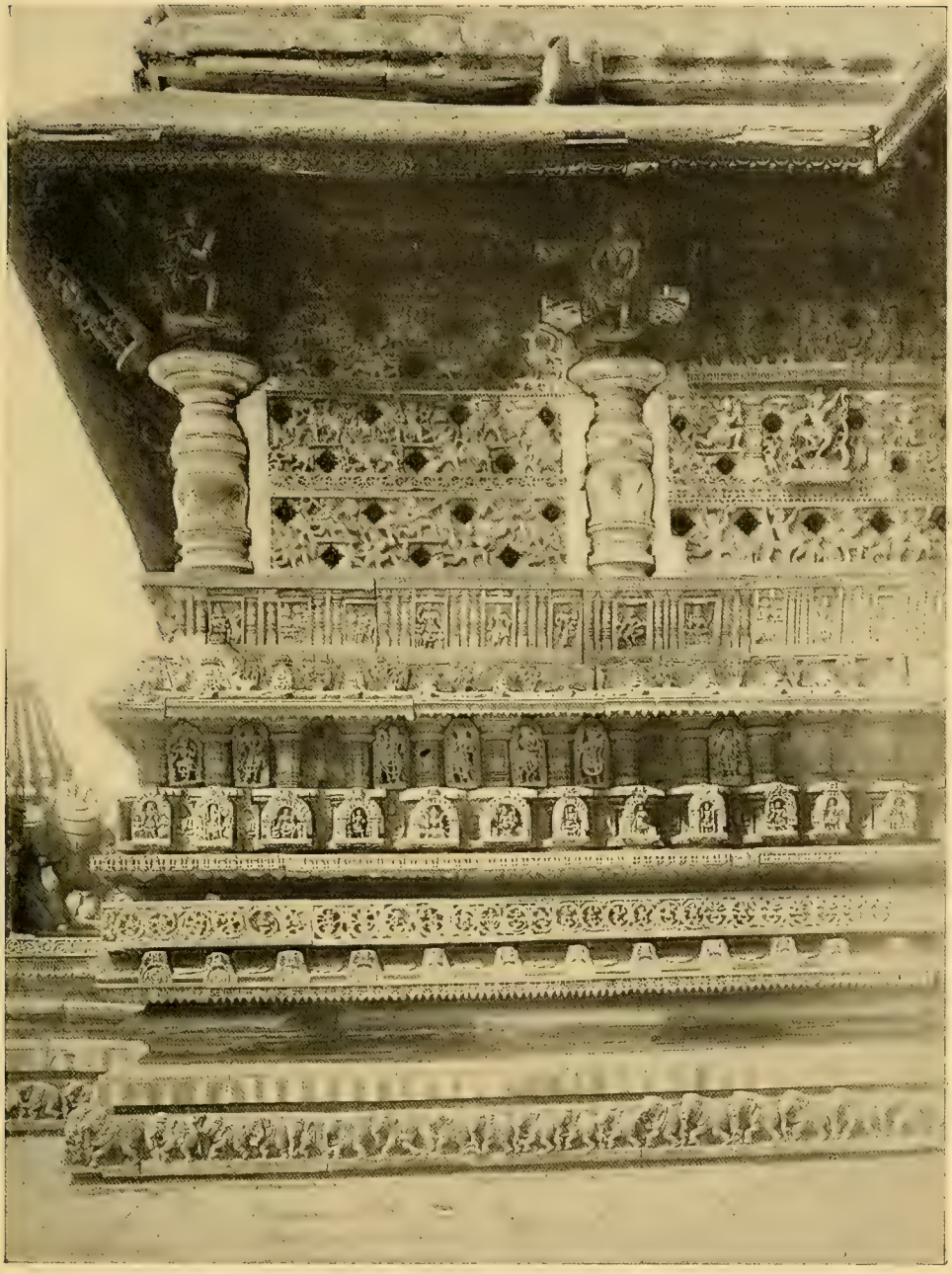
26. ANOTHER VIEW OF THE GREAT TEMPLE OF BHUVANESHWAR



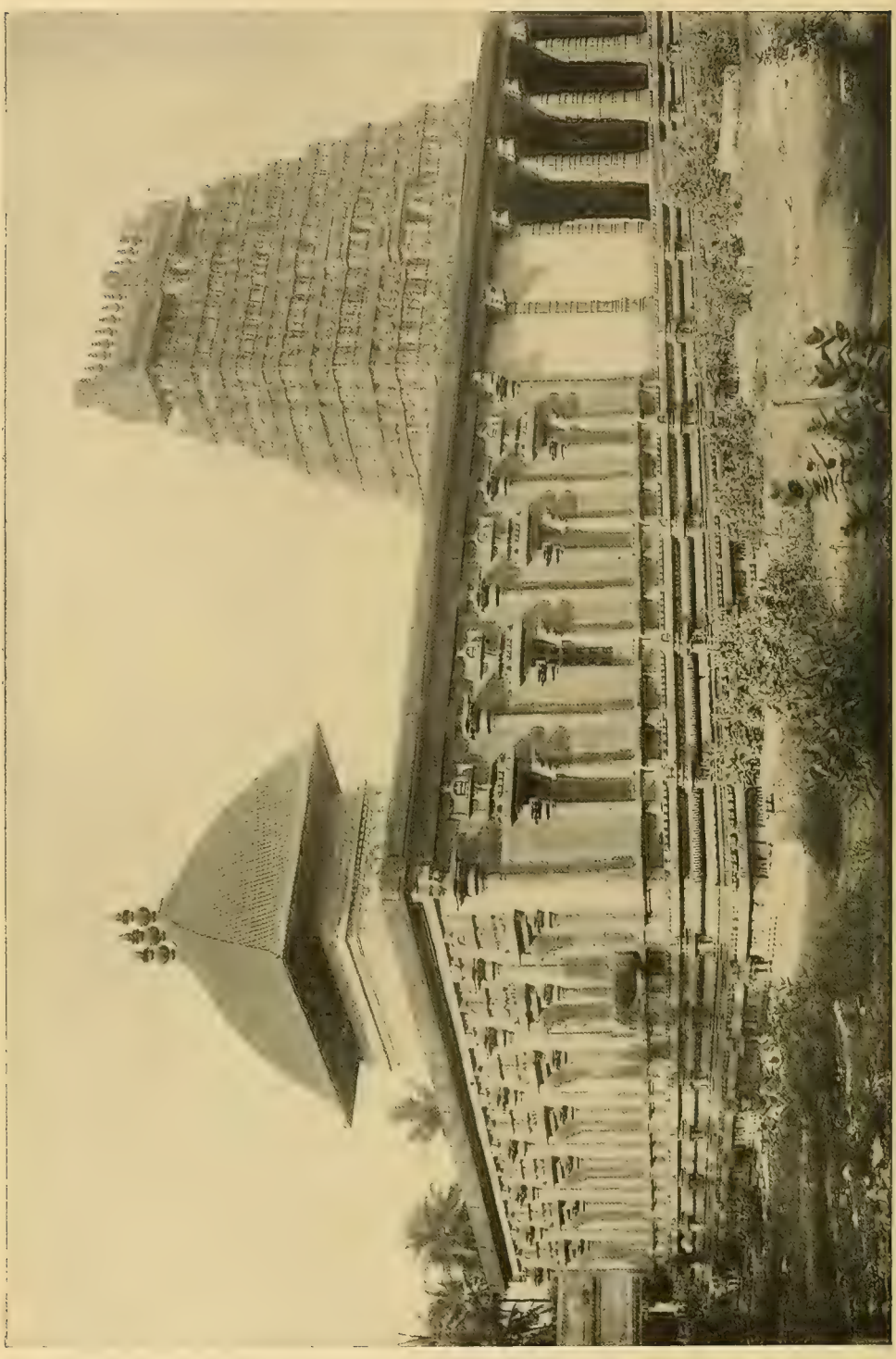


27. THE ROSE TEMPLE AT BIJOPUR

28. THE PALACE AT BIJOPUR, SUPPOSED TO CONTAIN HAIRS FROM THE PROPHET'S BEARD



29. THE MOST LABORIOUSLY WROUGHT CARVING IN THE WORLD



30. A WONDROUSLY RICH TEMPLE OF SOUTHERN INDIA, CHIDAMBARAM

31. A HINDU ASCETIC OR HOLY MAN

ably belongs to the second century A. D. The winged lions show the influence of Babylonian art.

12. Inner side of the North Toran at Sanchi.

13. Outer side of the East Toran at Sanchi.

14. Inner side of one pillar in East Toran, Sanchi, carved with scenes from the Jatakas, or Buddhist Birth Stories, the legends of early Buddhism.

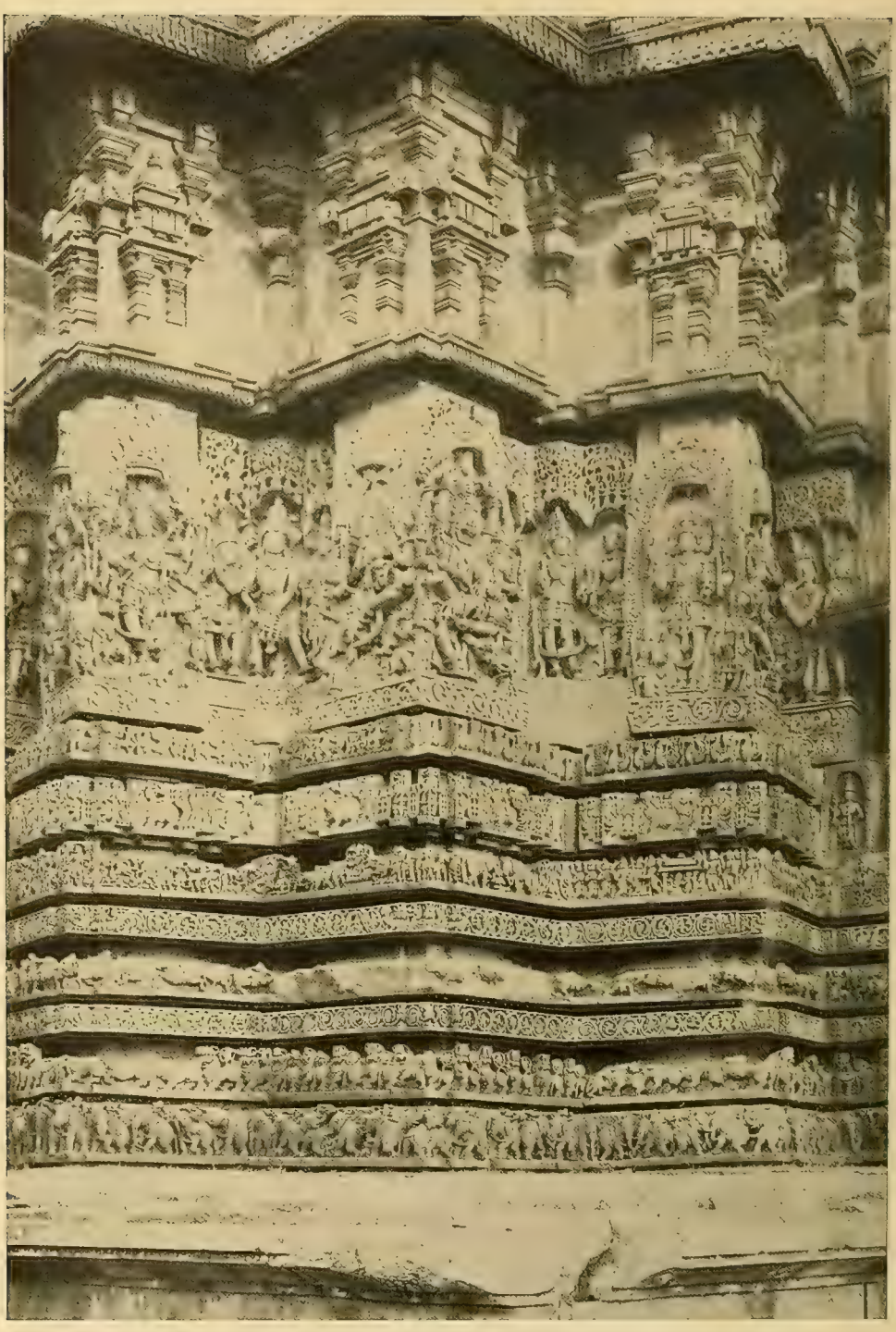
15. Inner side of the East Toran, Sanchi, upper section, where all created beings are shown worshiping the sacred relics (in a tope or relic casket) and the Sacred Tree. Note how different this picture is from the others. In the middle panel of the middle arch are to be seen all sorts of animals worshiping the Sacred Tree; on the right is the garuda, to the left of which is the maha or five-headed cobra, and to the left of this two oxen with faces of men. Other mythical animals are seen in the group.

16. Jai Singh, the Rajah of Jeypore, built observatories at Delhi and Jeypore, after the plans of his own, about the year 1724. This one at Delhi is most interesting to all astronomers—an equatorial dial 56 feet high, with a base of 104 feet and a hypotenuse of 118 feet. Jai Singh was an engineer as well as a mathematician and astronomer, and his ruined observatories are his best monument.

17. The Hauz, or Bath of the Emperor Jehangir, whose son built the Taj Mahal in memory of his wife, is an immense cistern of light-colored porphyry which stands in the center of the great court or armory square of the fort at Agra. It is 5 feet high and 8 feet in diameter and formerly stood in one of the inner courts of the adjoining palace.

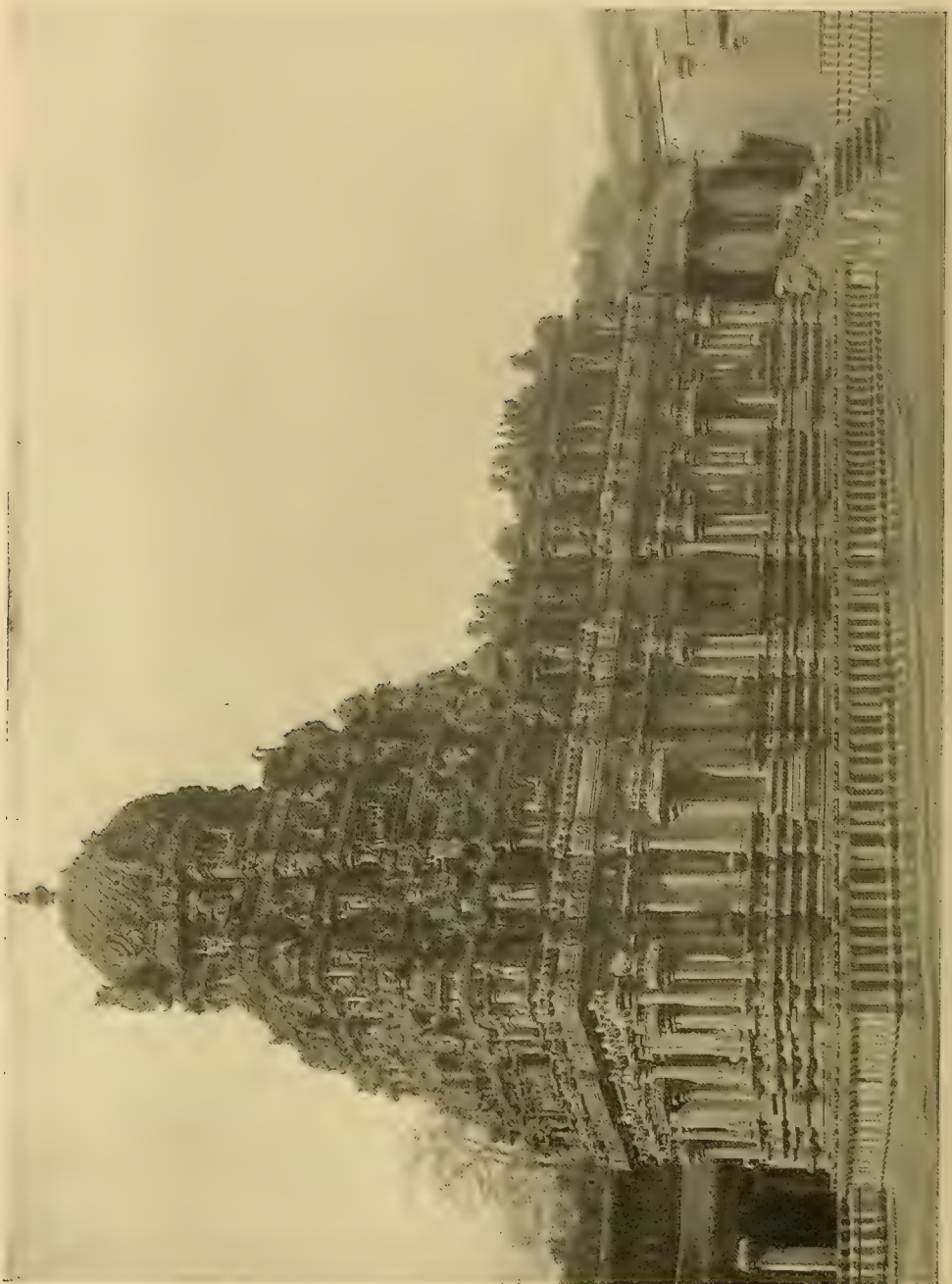
18. The Mosque at Fatteh pur Sikri is at one end of a vast court which its cloisters surround, and one may make the whole tour of the great quadrangle, passing through long series of arched doorways inlaid with fine mosaic.

19. The Tomb of Tughlak, 4 miles beyond the Kutub Minar at Old Delhi, is also a fort, the domed tomb with its mar-



32. ANOTHER MASTERPIECE OF SCULPTURED STONE: HULLABID

33. A UNIQUE SANSCRIT LIBRARY: TANJORE



34. A GEM OF DECORATIVE ARCHITECTURE: TANJORE

35. CORRIDOR IN THE GREAT TEMPLE AT RAMESWARAM: THE CORRIDOR IS 670 FEET LONG: THE PILLARS ARE MONOLITHS: THE TEMPLE HAS AN ANNUAL INCOME OF $200,000

36. A WANDERING MENDICANT OF SOUTHERN INDIA

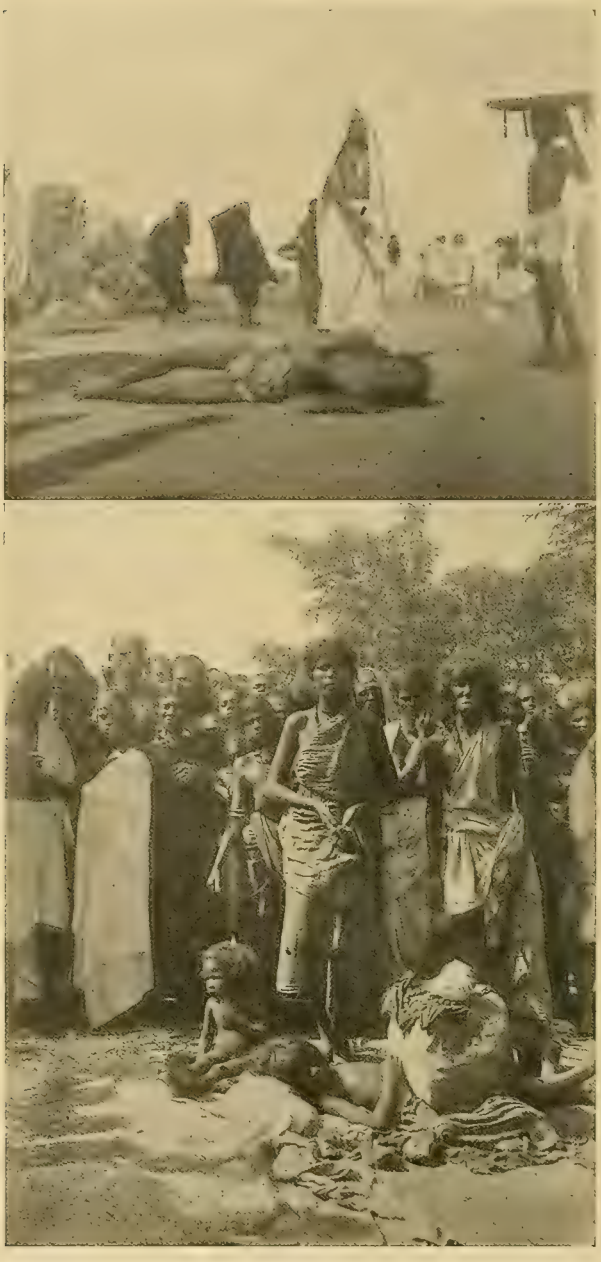
37. KARUPASAWING OR GOD WORSHIPED BY THE PEOPLE OF THE ROBBER CASTE

38. STUDENTS OF THEOLOGY: TANJORE

ble traceries being inclosed by a crenelated wall in pentagon shape; its severely simple lines, the inward slope of the walls below the marble dome, and of the encircling outer wall strongly suggesting Egyptian construction. It is a stern, severe mausoleum—an ideal warrior tomb.

20. The Panch Mahal, or five-storied pavilion of the Emperor Akbar in his palace at Fatteh pur Sikri, south of Agra. Each story recedes from the one below, and the top one, a mere kiosk, commands a magnificent view over the country and receives any passing breeze. This pavilion was a summer retreat for the emperor and his ladies. The parapets were formerly solid stone and the spaces between the pillars were filled with open-work stone screens, securing all privacy and shade. No two of the elaborately carved columns on the lower floor are alike.

21. Although the most famous and the best known of all the temples of India, this Temple of Jagannath, at Puri, on the Orissa coast, below Calcutta, is least visited by travelers. Hindu pilgrims visit it, however, and 100,000 are often present at festival times. These visitors heap money and jewels at the shrine, and the temple has an income of more than $150,000 per annum from its endowments and receives as much more in offerings each year. Six thousand priests, keepers, and attendants belong to the temples, and with the hangers-on and the families of all these there is a temple community of 20,000 supported by its funds. Jagannath is a form of Krishua, and his idol here is a rudely carved log which is dragged about in a magnificent car, and pilgrims are often injured in the crash and excitement. Thousands, of course, die of epidemic diseases during festival times. The temple as it now stands is 106 feet high and was built in the last century.



39. FANATIC ROLLING AROUND THE ROCK AT SECUNDERAMALAI

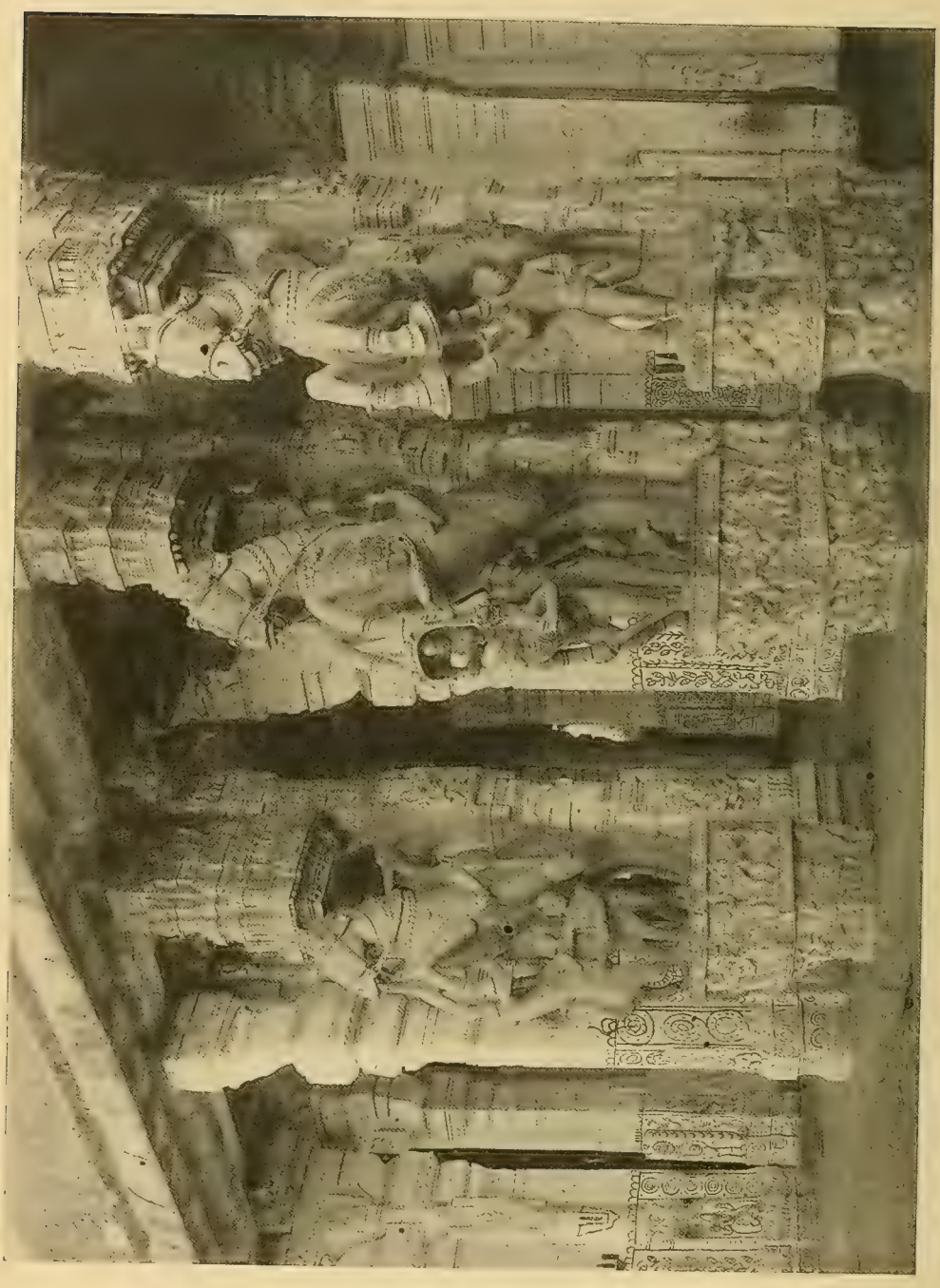
40. EXTORTING ALMS FROM PASSERS BY IN INDIA

41. STUDENTS OF THE VISHNU SECT: SOUTH INDIA

42. A HOLY MAN LYING ON A BED OF SPIKES

43. A ROBBER FAMILY

44. FOUR ROBBER CASTE MAIDENS



45. MARVELOUS STONE CARVING IN FRONT OF SIRI RANGAM, NEAR TRICHINOPLY. ANOTHER VIEW OF THE EXTRAORDINARY CARVING OF THIS TEMPLE IS SEEN IN NUMBER 46

22. This Great Temple at Bhuvaneshwar is called by Fergusson "the finest example of a purely Hindu temple in India." It was built in 617-657 A. D. The Great Tower is 55 feet high; every inch of its surface, course after course of stone, is covered with most intricate and elaborate carving.

23. Arch at the entrance of the Great Temple of Bhuvaneshwar, showing another style of architecture.

24. A watchman or Gate Guardian at Temple at Belur.

25. The famous Rock of Trichinoply rises to a height of 265 feet, access to the temples in the rock and on the summit being obtained by staircases and passages tunneled in the rock itself. The rock, like that of Gibraltar, is honeycombed with staircases, galleries, and chambers, with temples and guardrooms, with structures half hewn and half built on its summit. The great battle between the French and English was fought at the base of this rock. Throughout India there are similar rock fortresses.

26. Great Temple of Bhuvaneshwar from another point of view. There were formerly seven thousand temples at this sacred place, but only five hundred now remain surrounding the great lake or tank.

27. The Gol Gumbaz, or Round Dome or Rose Dome Temple at Bijapur, is the mausoleum of Muhammad Adil Shah and is remarkable for its simple grandeur and constructive boldness. It stands on a platform 600 feet square, each side of the building 196 feet. The seven-story tower or minarets at each corner are strangely like Chinese pagodas. The dome is 124 feet in diameter, and the great hall that it covers is 135 feet square—the greatest domed space in the world. There is a marvelous echo heard from the gallery below the dome. Muhammad, his youngest wife, his dancing girl, daughter, and sons lie in tombs in this hall. The small mosque at the edge of the platform is now the travelers' bungalow, where tourists are housed. The Gol Gumbaz was built in 1659.

28. The Palace at Bijapur is a relic house containing hairs of the prophet's beard. The great portico with three arches opens upon a courtyard and tank. The palace once contained a great library, and its marble and ivory-inlaid walls were coated with gold leaf.

29. The Temple of Chenna Kesava at Belur contains some of the most wonderful carvings in stone. It was built in the twelfth century to celebrate the conversion to Vishnuism of a Jain ruler. Fergusson says of this particular porch: "The amount of labor which each particular facet of this porch displays is such as never was bestowed on any surface of equal extent in any building in the world."

30. The Temple (Shrine) at Chidambaram and great gopura in background. The gopuras, or pagodas, at Chidambaram are the oldest in southern India and marvels of sculptured ornament. The temple is enormously rich and contains an unequaled treasury of jewels and silver cars.

31. Holy man with an armful of peacock feathers and his head in an iron cangue that prevents him from lying down or leaning back.

32. The Temple at Hullabid, 10 miles from Belur, is another masterpiece of sculpture and full relief ornament. It is greatly ruined now and many of its gems have been removed to the Museum at Bangalore. When intact it was the finest specimen of Indian art in existence. This column is one "of the most marvelous exhibitions of human labor to be found even in the patient East;" . . . "far surpasses anything in Gothic art. The effects are just what the medieval architects were often aiming at, but which they never attained so perfectly as was done at Hullabid." Fergusson further says, placing this Hullabid Temple and the Parthenon as the two extremes of architecture: "It would be possible to arrange all the buildings of the world between these two extremes, as they tended toward the severe intellectual purity of the one or the playful, exuber-

ant fancy of the other; but perfection, if it existed, would be somewhere near the mean."

33. In the Palace at Tanjore the library is particularly rich in Sanscrit manuscripts, some 18,000 being stored there, and 8,000 of them are like these wood-bound volumes, consisting of strips of talipot palm leaves engraved with a sharp metal stylus. It is the unique Sanscrit library of India, collected there in the sixteenth century.

34. This little Temple of Subramanya in the court of the Great Temple at Tanjore, was built in the sixteenth century and is regarded as the gem of decorative architecture of Dravidian art.

35. The Great Temple of Rameswaram at the extreme southern end of India, facing Adam's Bridge, or the chain of islets that connect it with Ceylon, is fairly one of the wonders of the world. The temple enclosure is 1,000 feet square, the gate 100 feet high, and of carved and painted corridors, like this one, which is 670 feet in length, there are altogether in the temple, corridors that make a total of 4,000 feet of such impressive splendor. The temple was founded by Rama in the age of fable; it has an endowed income of quite $200,000 per annum, and is the goal of pilgrims from every part of India.

36. A Samayasi or itinerant monk—one of the holy men who roam India, begging their way, and who are never sent to the workhouse.

37. The robbers never go out on a stealing expedition without first getting consent of their god.

38. Brahman boys studying to be priests in the Temple at Tanjore. The marks on their foreheads are sacred ashes, and indicate that they are worshipers of Vishnu.

39. Penitents and fakirs may be seen fulfilling the most absurd vows at all the sacred places of India. This fanatic is rolling over and over on the road that makes the circuit of the rock at Secunderamalai, a distance of 3 miles.

40. The parents of this child are not doing penance for their own sins by placing this crushing rock on the body, but are merely trying to move the sympathetic to give alms.

41. Boy with Kavadi or festival decoration carried over his head. The Brahmans surrounding him have the mark of Vishnu painted on their foreheads.

42. A fakir or Hindu Samayasi lying on a bed of pointed nails.

43 and 44. The rigid caste system of India, with its four great divisions which have been for many centuries rigidly defined, has always excited the wonder of the white man.

The Brahmans are said to have sprung from the head of the creator Brahma. Being thus born from his noblest part, they are, by birth, preëminent in dignity and holiness. They are the priests and law-givers of the nation.

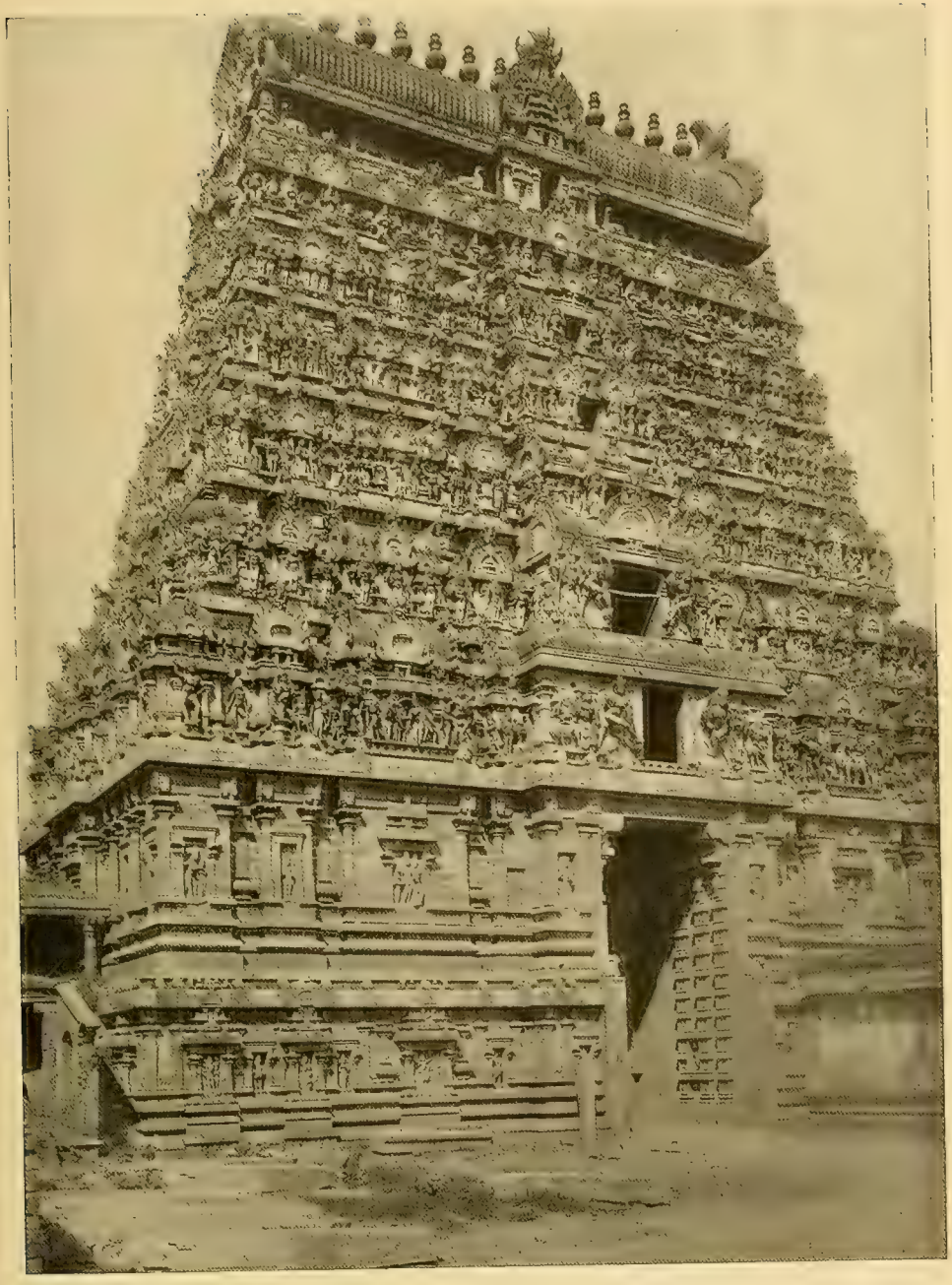
The Kschatryas, or warriors, sprang from the shoulders of Brahma, and fill the kingly and military offices.

The Vaisyas, or husbandmen, sprang from the body of the god. It is their duty as merchants and traders to care for the wants of the state.

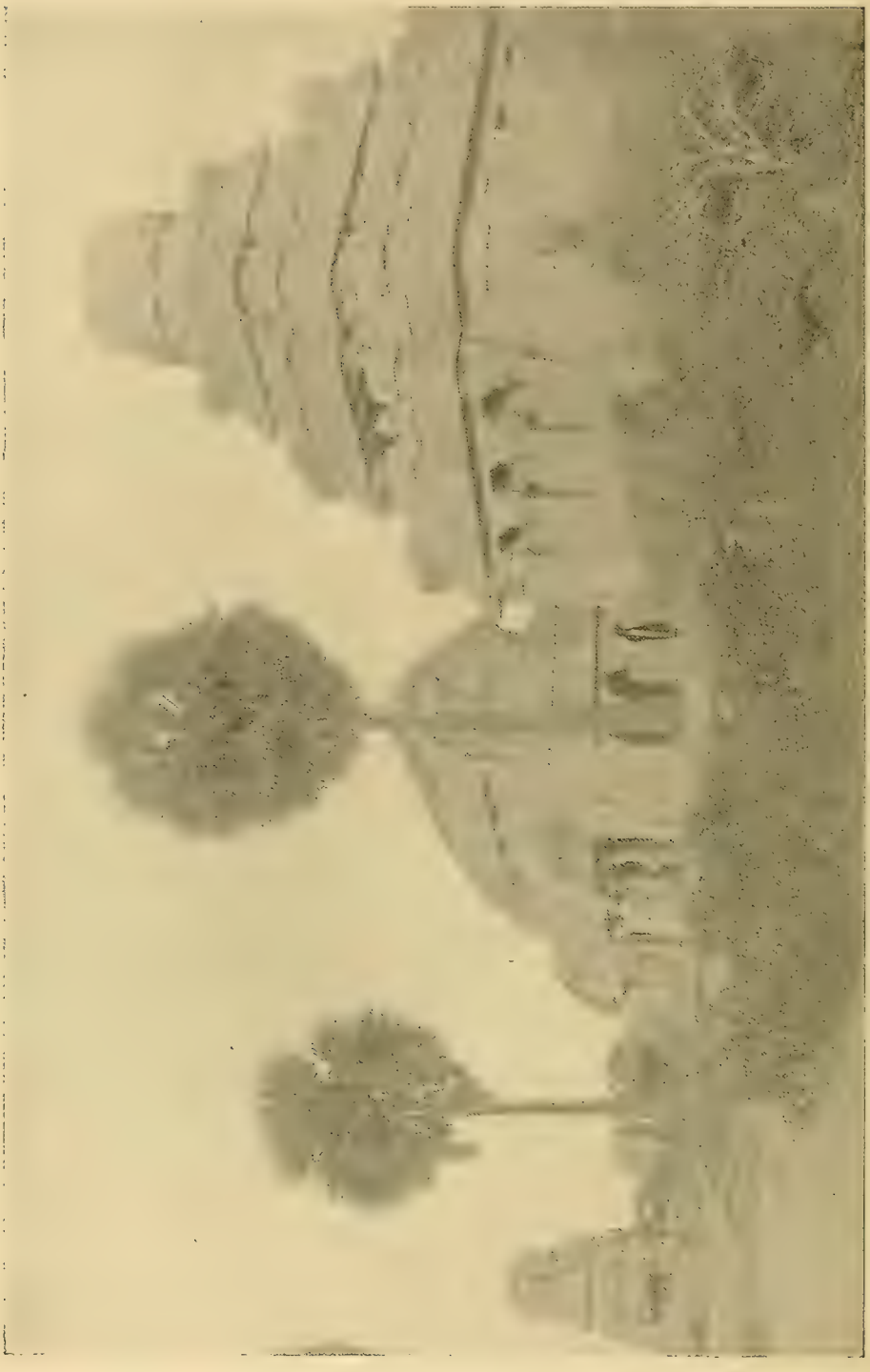
The Sudras, or servants, sprang from his feet. They are therefore subordinate to all, and must, by mechanical and servile labors, contribute to the happiness of the high born, especially to that of the Brahmans.

The military caste and mercantile caste have become almost extinct, leaving the Brahmans and Sudras as the two great divisions. These two have again been subdivided into many tribes and castes, so that it is commonly said that there are eighteen chief and one hundred and eight minor castes.

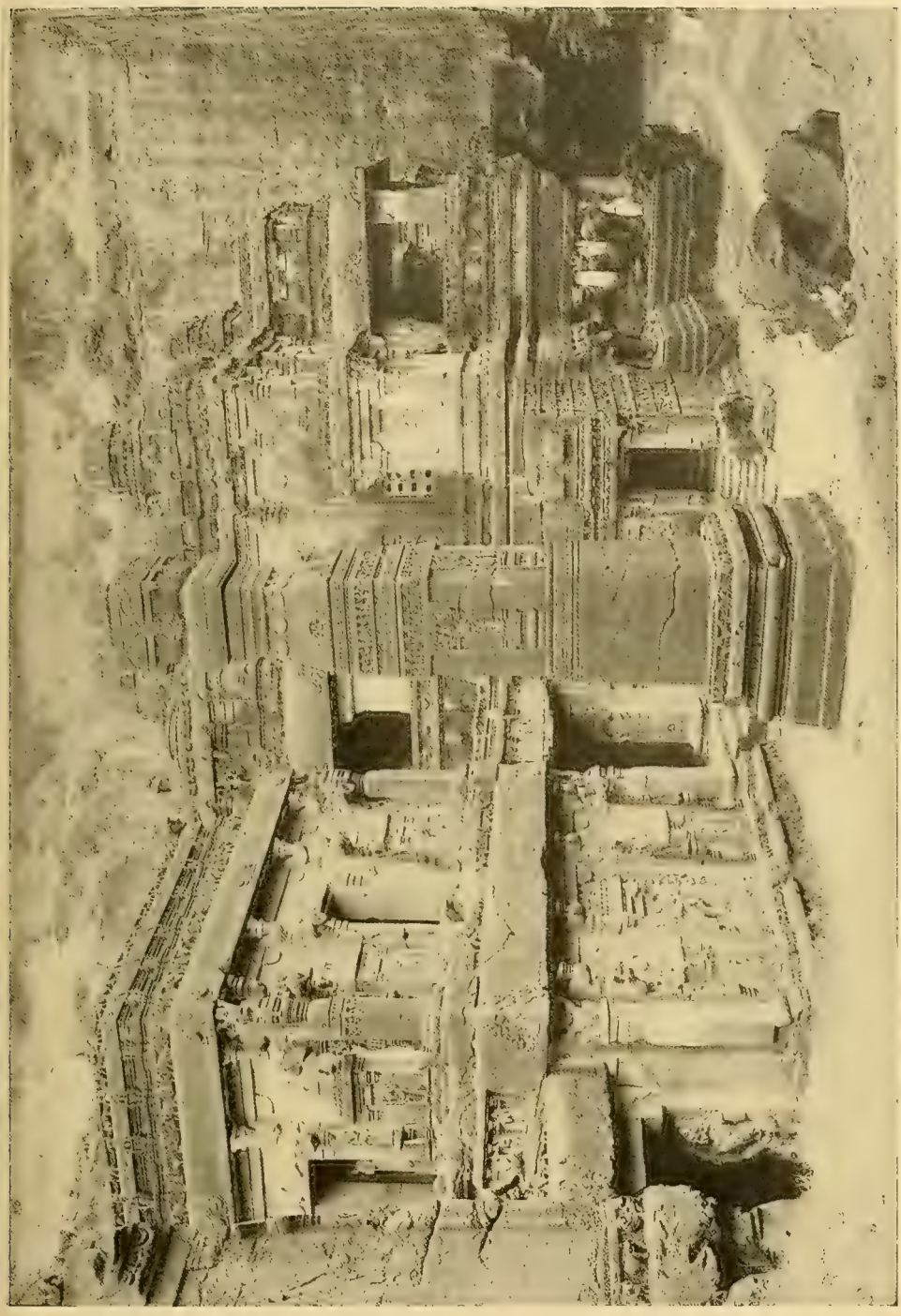
"The number of castes will not excite wonder, when it is remembered that almost every employment or profession forms a separate caste. The members of these subdivisions, though belonging to the same great caste, will not intermarry, nor will they eat, drink, or associate with each other. Thus, physicians form a separate caste, the druggists another, the shepherds another, and so on with herdsmen, barbers, writers, farmers, carpenters, goldsmiths, masons, blacksmiths,



46. THE GREAT TOWER OVER THE ENTRANCE TO THE HINDU TEMPLE AT SIRI RANGAM

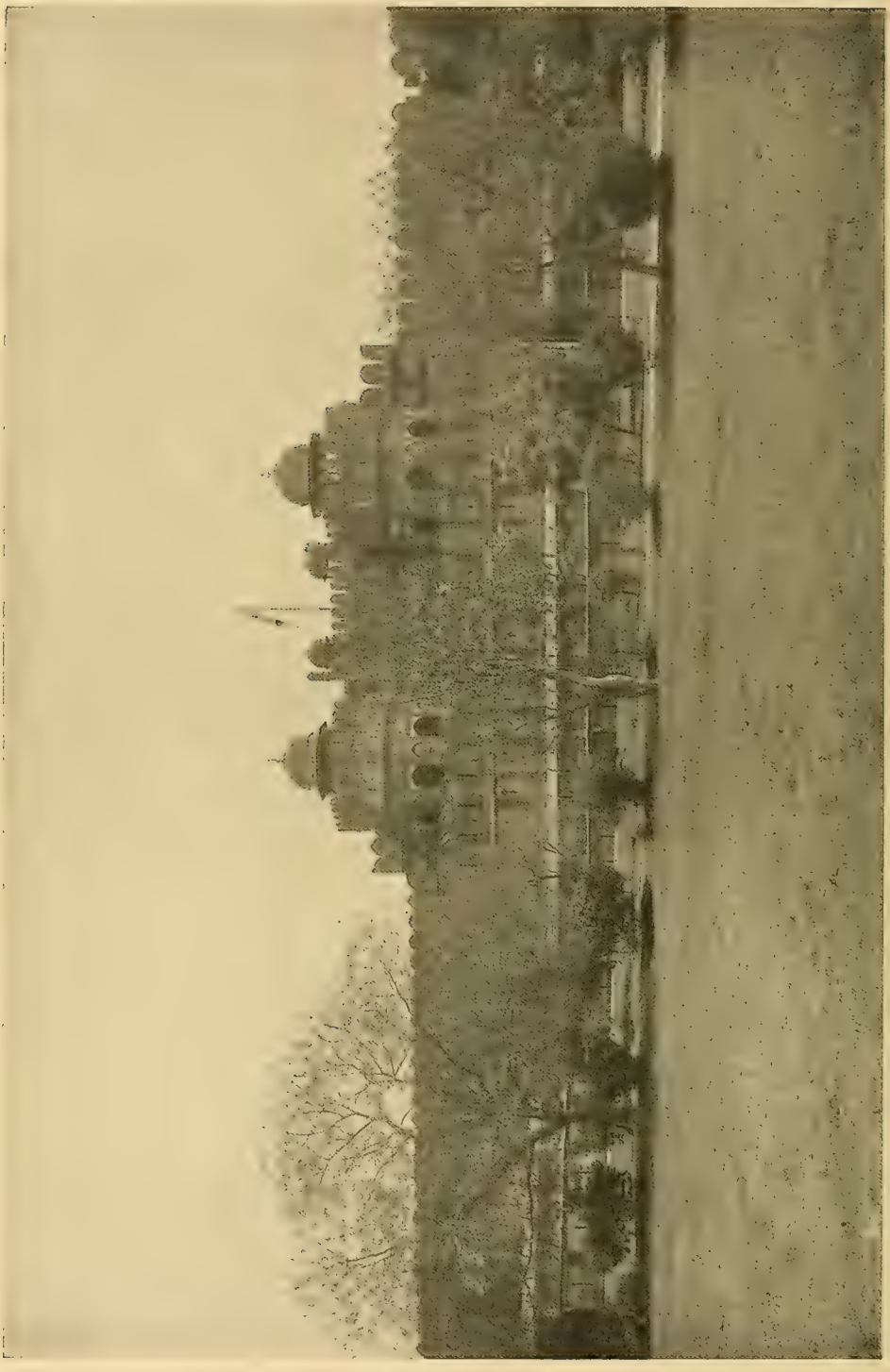


47. THE ROCK-CUT TEMPLES OF MAHALIPURA, NEAR MADRAS

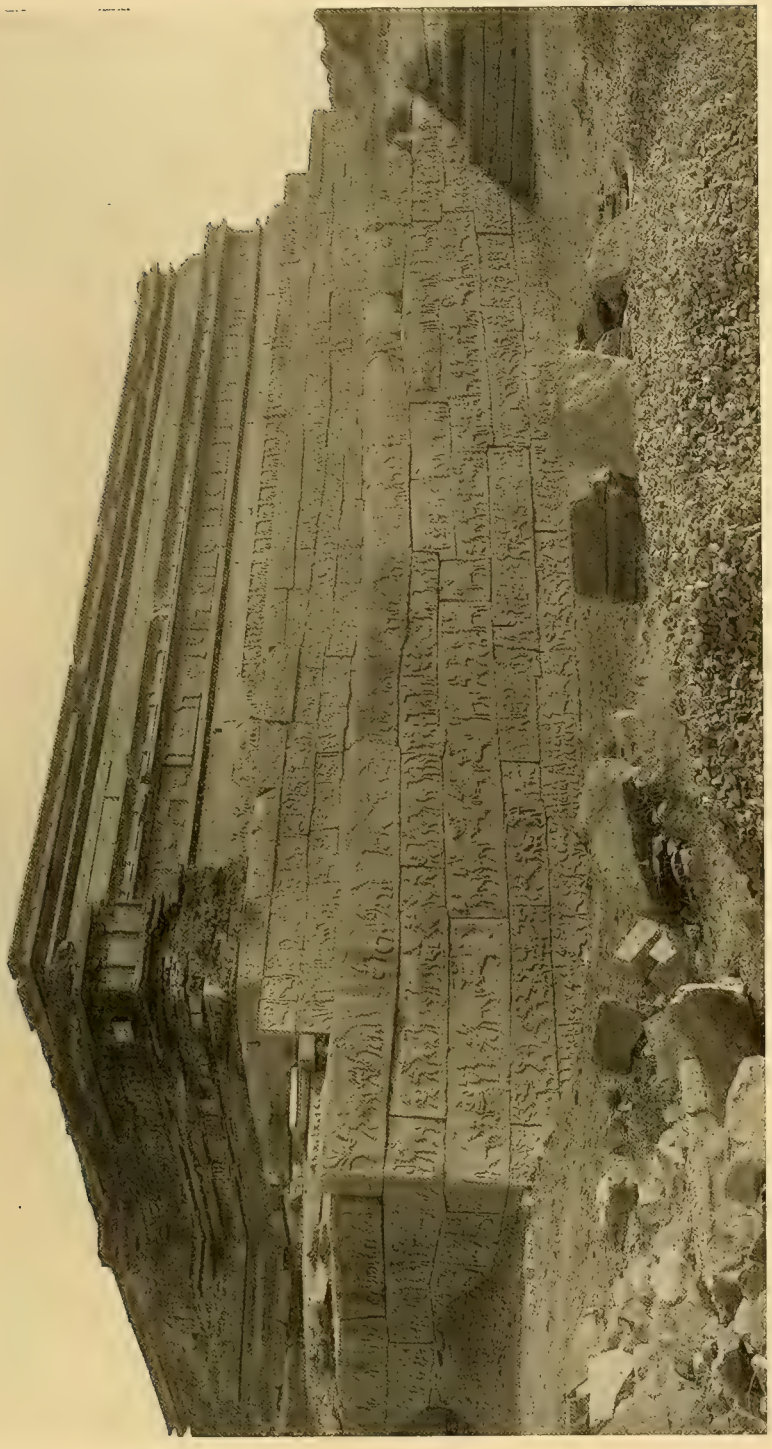


48. THE KAILAS OR ROCK-CUT TEMPLE AT ELORA

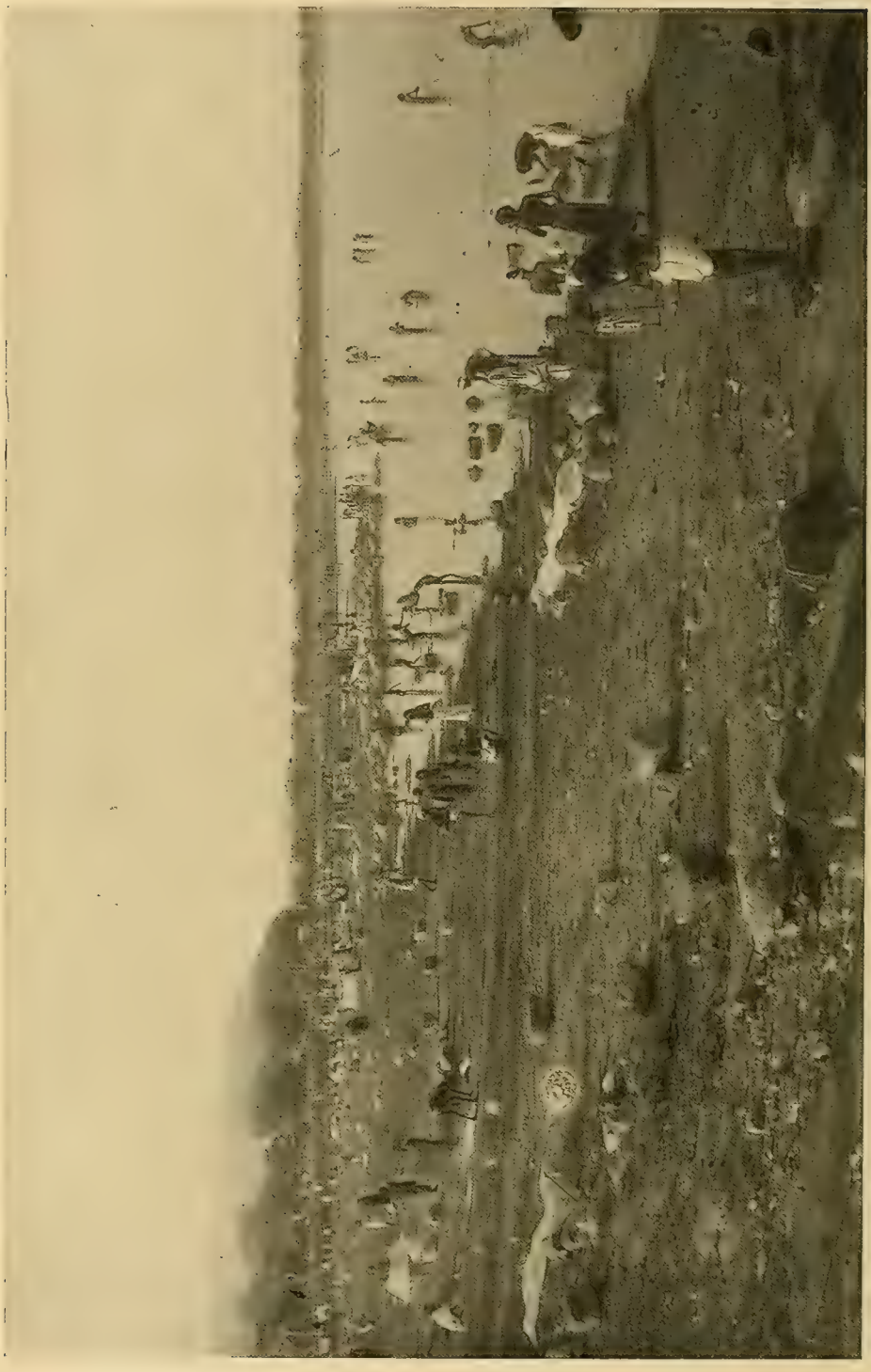
This temple is cut from the face of the rock, the interior being cut out and taken away, so that the effect is of a temple that has been constructed



49. GATEWAY TO THE FORT AT AGRA, BUILT BY AKBAR THE GREAT

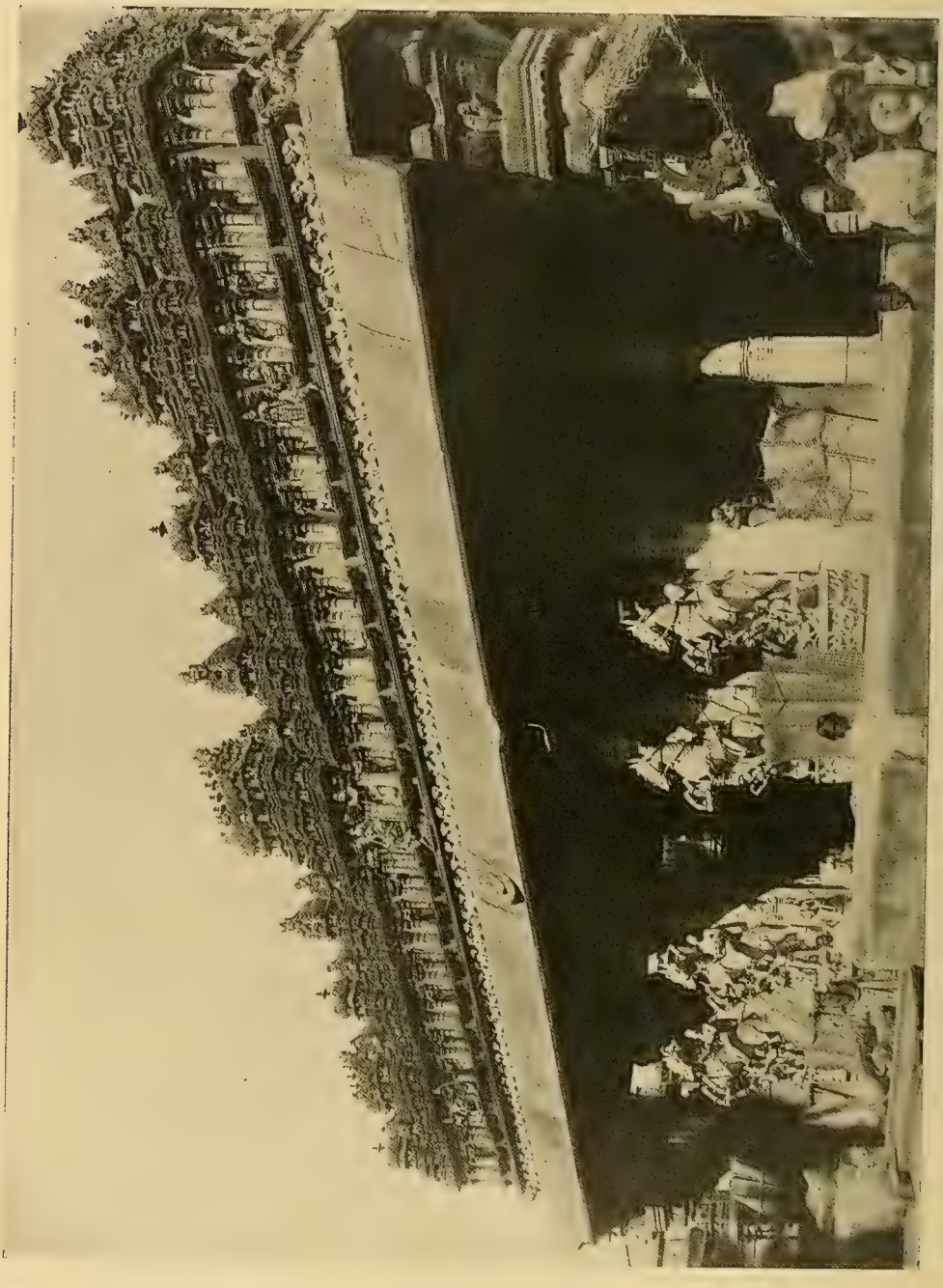


50. OPEN THRONE IN RUINS OF HAMPI



51. MORNING BATH AND TOILET OF THE PIOUS AT SECUNDERAMALAI, NEAR MADURA

52. CROWD OF HINDUS AT A RELIGIOUS FESTIVAL AT SECUNDERAMALAI, NEAR MADURA



53. ENTRANCE TO THE GREAT TEMPLE OF MADURA

and many other trades. The blacksmith will not marry into the family of the weaver, nor will he eat or drink with him, nor will the carpenter with the shepherd, nor the accountant with the mason. Each profession is handed down from father to son. Before his birth the calling of the man is decided and his associations fixed. Society is thus made up, not of men, but of castes, and man sympathizes, not with his fellow-man, but with his caste. No success, no genius, no virtue, can lift him out of the caste in which he was born, and no crime, except a breach of caste, can degrade him from it. This the Hindu believes to be the ordinance and will of God. His place in society was fixed at the creation."

Of recent years the influences of British rule, of Occidental ideas, and particularly of railways, have greatly lessened the stringency of the caste system.

45. The famous Horse Columns in front of the Hall of a Thousand Columns in the third court of the Great Temple of Siri Rangam, 2 miles outside of Trichinoply. Men on rearing horses are shown spearing tigers, the horses' feet resting on the shields of men on foot beside them. The temple possesses a rich treasury of jewels.

46. The Great Gopura or Tower of the Temple at Siri Rangam, 152 feet in height, covered with course after course of gods, warriors, men, and horses carved in everlasting stone.

47. This group of monolithic temples at Mahalipura were cut from boulders as long ago as the fourth and sixth centuries—so early, in fact, that the only architectural models were the wooden churches and monasteries of the Buddhists, which they precisely repeat and preserve as records. Two of the five temples (four only are shown in the picture) are mere image-cells, ponderous sentry-boxes cut from some granite outcropping or stray boulder left in geologic days, each with its archaic stone lion or elephant standing guard beside it. Each stands free and complete, carved from base to finial, the coarse yellow granite showing no seams or crevices save those left by earthquake shock. Of the three larger temples which are grouped together, the Split Temple (the central figure) is forty-two feet long and twenty-five feet high. The exterior was first shaped and carved, and then the interior was hollowed out, leaving such slender lion columns to support the massive entablature and cornices and the solid barrel vault of the second story, that angles and pieces of the cornice fell away and the solid walls gaped in cracks that show the sky. If an earthquake caused these cracks, it was enough, apparently, to discourage any further work, and all five raths are left incomplete, their interiors still in the rough, the altars and objects of worship never made ready. A few Sanskrit inscriptions give clue to the era of their sculpture, but nothing of record of their real history is known.

The little four-story vihara shown next the Split Temple is twenty-seven feet square and thirty-four feet high. Its exterior is finished, but the work of excavating the interior and the upper rows of cells had apparently only begun when the work stopped, never to be resumed, and only the lizards live and move in these monuments of the great city of Bali.

48. At Ellora, a night's journey from Bombay, there is a series of cave temples, opening from a path or shelf along a cliff front, that extend for a mile and a half in continuous line. All three religions—Buddhist, Brahman, and Jain—had their temples in this wall of trap rock and vied with one another in size and elaboration. The thirty-four complete temples were hollowed out and sculptured during the sixth, seventh, and eighth centuries—all to rouse the same fury of destruction in the Moslem conquerors, who wreaked themselves on the carvings of every single cave, and chamber, and vihara cell, and left not one face unharmed in the thousands of images, figures, and heads. Every nose was struck off by the invaders, and whole heads when they had the time; and now the stain of oil, the litter of flower gar-

54. VIEW OF MADURA FROM THE TOWER OF THE AMERICAN MISSION CHURCH, SHOWING THE GOPURAS OR TOWERS OF THE GREAT TEMPLE OF MEENAKSHI

lands, and the daubs of ocher show that the old religions survive and worshipers are faithful to their traditions and religious festival days.

Two and three-story temples succeed to one's bewilderment, communicating staircases and galleries hewn in the living rock leading from one to another, until one is quite lost. Great halls and chambers, their walls covered with sculpture, every recess holding its image cut from the living rock, are shut from the outer world by rock screens, or galleried walls, whose windows are placed so that the light shall fall on altar, or image, or dagoba, as at Karli, just as the golden statue at Buddha-Gaya was illuminated by the rising sun long before Ellora was known. Bats scream and beat their wings in many dark chambers, which the noisome odor keeps the most industrious visitor away from, and even in the dry, cold weather one has a proper fear of a lurking cobra.

In the so-called Carpenter's Cave, a wooden chaitya hall is exactly imitated in this underground burrowing, even the ribbed ceiling and the heavy joists and beams are imitated in the living rock, as are the dagoba and the seated image of Buddha.

All else at Ellora and elsewhere pales beside the Kailas, the supreme effort of rock-cutters' work, where a court, ninety feet deep and more than one hundred and fifty feet square, was sunk in the solid rock at the edge of the cliff. A rock wall, or screen, was left, as a gateway to the sunken court, and then the detached rock mass, standing free in its midst, was carved over to the outward semblance of an elaborate, two-story, Dravidian temple, and hollowed out into chambers and image halls. The carved columns for flags and lamps remain, the life-sized elephants stand waiting, the sacred bull rests on his pedestal, and all is as complete as anything masons ever constructed. A two-story series of carved chambers surround the court, cave cloisters as elaborately ornamented as the halls of the temple itself. One may walk around the Kailas, view it from different levels from every side, but unfortunately the camera cannot have range enough to reproduce anything but sections. The Ellora caves are cleared of underbrush and rubbish, and well looked after, and railway communication has lately made them easily accessible.

49. Akbar, the greatest Asiatic monarch of modern times, built this fortress about 1580. His empire included the whole of Hindustan north of Deccan. The city of Agra is greatly venerated by the Hindus, as it was the scene of the incarnation of Vishnu under the name of Parasu Rama.

50. The series of figures represent triumphal processions returning from battle.

51. Cleanliness of person and clothing is partially secured by the Hindu custom of bathing and worship at sunrise each morning. The pious ones wade into the stream, as here at Secunderamalai, and after prayers and ablutions drop their winding draperies of white head sheets and wash them. They spread them out on the sand and stones of the river bank and in a few minutes they are dry and may be draped over head and shoulders.

52. It is about 2 miles around the rock, and every one who goes to the festival joins the procession around the rock. The temple at the foot of the rock (not visible) is the Temple of Subrananiam.

53. The Horse Columns of the Pudu Mandapam in the Great Temple of Madura; this great hall was built in 1623-1645, but was never completely finished. Were there not other wonders in India yet greater, these horse columns would be sufficient to make the fame of any temple.

54. The five Great Gopuras of the Madura temple as seen from the tower of the American Mission Church. The space within the enclosure guarded by these enormous gate towers is filled with a labyrinth of shrines, pavilions, courts, cloisters, tanks, and passages. The treasury contains some of the finest pearls and sapphires in all India.

THE HEART OF THE ANTARCTIC

By Lieut. Ernest H. Shackleton

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In the April, 1909, number of the National Geographic Magazine there was printed a summary of the geographical results of Lieutenant Shackleton's South Polar Expedition of 1908–09. The narrative of the extraordinary achievements of his party, which included reaching a point within 110 miles of the South Pole, attaining the South Magnetic Pole, and climbing the lofty summit of the volcano, Mount Erebus, is published this month by J. B. Lippincott Company of Phliadelphia, and by courtesy of the publishers the following extracts and illustrations are reprinted here.

Lieutenant Shackleton tells the story of his work simply and modestly in two handsome volumes, beautifully illustrated from photographs and with large maps in colors. An introduction by Hugh Robert Mill summarizes the work of previous south polar expeditions.

MEN go out into the void spaces of the world for various reasons. Some are actuated simply by a love of adventure, some have the keen thirst for scientific knowledge, and others again are drawn away from the trodden paths by the "lure of little voices," the mysterious fascination of the unknown. I think that in my own case it was a combination of these factors that determined me to try my fortune once again in the frozen south.

I had been invalided home before the conclusion of the *Discovery* expedition, and I had a very keen desire to see more of the vast continent that lies amid the Antarctic snows and glaciers. Indeed, the stark polar lands grip the hearts of the men who have lived on them in a manner that can hardly be understood by the people who have never got outside the pale of civilization.

The *Discovery* expedition had gained knowledge of the great chain of mountains running in a north and south direction from Cape Adare to latitude 82° 17′ south, but whether this range turned to the southeast or eastward for any considerable distance was not known, and therefore the southern limits of the Great Ice Barrier plain had not been defined.

The glimpses gained of King Edward VII Land from the deck of the *Discovery* had not enabled us to determine either its nature or its extent, and the mystery of the Barrier remained unsolved. It was a matter of importance to the scientific world that information should be gained regarding the movement of the ice-sheet that forms the Barrier. Then I wanted to find out what lay beyond the mountains to the south of latitude 82° 17′ and whether the Antarctic continent rose to a plateau similar to the one found by Captain Scott beyond the Western Mountains.

There was much to be done in the field of meteorology, and this work was of particular importance to Australia and New Zealand, for these countries are affected by weather conditions that have their origin in the Antarctic. Antarctic zoology, though somewhat limited, as regarded the range of species, had very interesting aspects, and I wanted to devote some attention to mineralogy, apart from general geology.

The Aurora Australis, atmospheric electricity, tide movements, hydrography, currents of the air, ice formations and movements, biology and geology, offered an unlimited field for research, and the

VIEW OF THE GREAT ICE BARRIER WHICH EXTENDS FOR 500 MILES ACROSS FROM KING EDWARD VII LAND TO MOUNT EREBUS

dispatch of an expedition seemed to be justified on scientific grounds quite apart from the desire to obtain a high latitude.

When I found that some promises of support had failed me and had learned that the Royal Geographical Society, though sympathetic in its attitude, could not see its way to assist financially, I approached several gentlemen and suggested that they should guarantee me at the bank, the guarantees to be redeemed by me in 1910, after the return of the expedition. It was on this basis that I secured a sum of £20,000, the greater part of the money necessary for the starting of the expedition, and I cannot express too warmly my appreciation of the faith shown in me and my plans by the men who gave these guarantees, which could be redeemed only by the proceeds of lectures and the sale of my book after the expedition had concluded its work.*

* On his return from "Farthest South," the British government made Lieutenant Shackleton a grant of £20,000 to redeem these pledges.

FOODS TO PREVENT SCURVY

Several very important points have to be kept in view in selecting the food supplies for a polar expedition. In the first place, the food must be wholesome and nourishing in the highest degree possible. At one time that dread disease scurvy used to be regarded as the inevitable result of a prolonged stay in the ice-bound regions, and even the *Discovery* expedition, during its labors in the Antarctic in the years 1902-4, suffered from this complaint, which is often produced by eating preserved food that is not in a perfectly wholesome condition. It is now recognized that scurvy may be avoided if the closest attention is given to the preparation and selection of foodstuffs along scientific lines, and I may say at once that our efforts in this direction were successful, for during the whole course of the expedition we had not one case of sickness attributable directly or indirectly to the foods we had brought with us. Indeed, beyond a few colds, apparently due

THE "NIMROD" PUSHING THROUGH HEAVY PACK ICE ON HER WAY SOUTH, CARRYING THE SHACKLETON PARTY

to germs from a bale of blankets, we experienced no sickness at all at the winter quarters.

In the second place, the food taken for use on the sledging expeditions must be as light as possible, remembering always that extreme concentration renders the food less easy of assimilation, and therefore less healthful. Extracts that may be suitable enough for use in ordinary climates are of little use in the polar regions, because under conditions of very low temperature the heat of the body can be maintained only by use of fatty and farinaceous foods in fairly large quantities. Then the sledging foods must be such as do not require prolonged cooking—that is to say, it must be sufficient to bring them to the boiling point, for the amount of fuel that can be carried is limited. It must be possible to eat the foods without cooking at all, for the fuel may be lost or become exhausted.

Some important articles of food were presented to the expedition by the manufacturers, and others, such as biscuits and pemmican, were specially manufactured to my order. The question of packing presented some difficulties, and I finally decided to use "venesta" cases for the foodstuffs and as much as possible of the equipment. These cases are manufactured from composite boards prepared by uniting three layers of birch or other hard wood with waterproof cement. They are light, weather-proof, and strong, and proved to be eminently suited to our purposes. The cases I ordered measured about two feet six inches by fifteen inches, and we used about 2,500 of them. The saving of weight, as compared with an ordinary packing case, was about four pounds per case, and we had no trouble at all with breakages, in spite of the rough handling given our stores in the process of landing at Cape Royds after the expedition had reached the Antarctic regions.

FUR CLOTHING OF THE BEST

Our furs did not make a very large order, for after the experience of the

THE HUT IN THE EARLY WINTER

The building was made in England and shipped in sections all ready to be put together when the party landed. The hut was lit with acetylene gas

Discovery expedition I decided to use fur only for the feet and hands and for the sleeping bags, relying for all other purposes on woolen garments with an outer covering of wind-proof materials. I ordered three large sleeping bags, to hold three men each, and twelve one-man bags. Each bag had the reindeer fur inside, and was lined with leather and specially strongly sewn.

The one-man bags weighed about ten pounds when dry, but of course the weight increased as they absorbed moisture when in use.

The foot-gear I ordered consisted of eighty pairs of ordinary finnesko, or reindeer fur boots, twelve pairs of special finnesko, and sixty pairs of ski boots of various sizes. The ordinary finnesko is made from the skin of the reindeer stag's head, with the fur outside, and its shape is roughly that of a very large boot without any laces. It is large enough to hold the foot, several pairs of socks, and a supply of sennegrass, and it is a wonderfully comfortable and warm form of foot-gear.

The special finnesko are made from the skin of the reindeer stag's legs, but they are not easily secured, for the reason that the native tribes, not unreasonably, desire to keep the best goods for themselves. I had a man sent to Lapland to barter for finnesko of the best kind, but he only succeeded in getting twelve pairs. The ski boots are made of soft leather, with the upper coming right round under the sole, and a flat piece of leather sewn on top of the upper. They are made specially for use with ski, and are very useful for summer wear. They give the foot plenty of play and do not admit water. The heel is very low, so that the foot can rest firmly on the ski. I bought five prepared reindeer skins for repairing and a supply of repairing gear, such as sinew, needles, and waxed thread.

THE MANCHURIAN PONIES ON QUAIL ISLAND, PORT LYTTELTON, BEFORE THE EXPEDITION LEFT FOR THE ANTARCTIC

Eight ponies were taken to the south polar regions and of these the white ones proved the hardiest

THE FOUR PONIES OUT FOR EXERCISE ON THE SEA ICE

GRASS USED IN THE SHOE TO PREVENT FREEZING

I have mentioned that sennegrass is used in the finnesko. This is dried grass of long fiber, with a special quality of absorbing moisture. I bought fifty kilos (109.37 pounds) in Norway for use on the expedition. The grass is sold in wisps, bound up tightly, and when the finnesko are being put on some of it is teased out and a pad placed along the sole under the foot. Then when the boot has been pulled on more grass is stuffed round the heel. The grass absorbs the moisture that is given off from the skin, and prevents the sock freezing to the sole of the boot, which would then be difficult to remove at night.

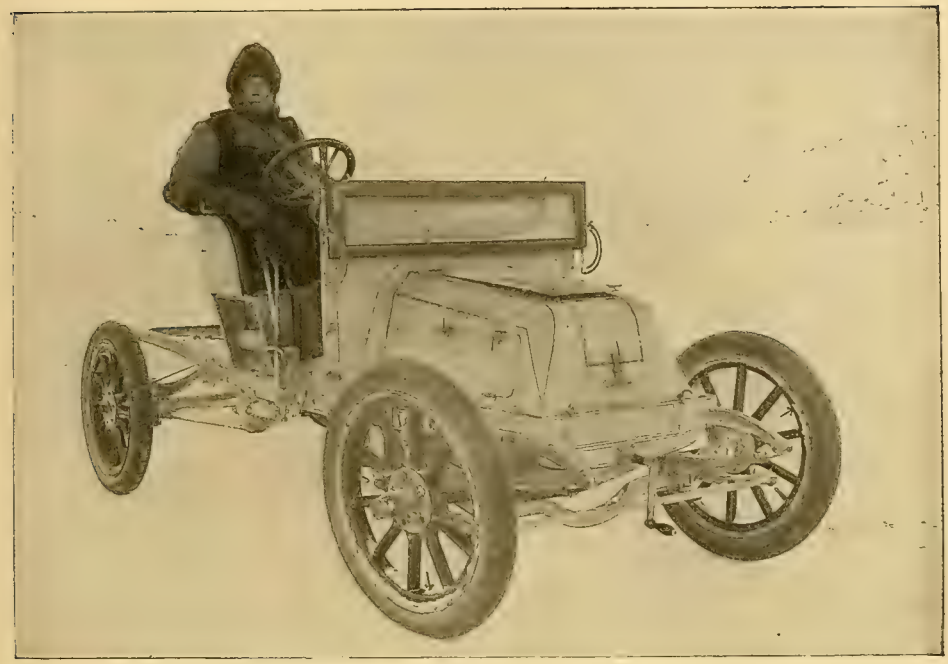
The grass is pulled out at night, shaken loose, and allowed to freeze. The moisture that has been collected congeals in the form of frost, and the greater part of it can be shaken away before the grass is replaced on the following morning. The grass is gradually used up on the march, and it is necessary to take a fairly large supply, but it is very light and takes up little room.

For use on the sledging expeditions I took six "Nansen" cookers made of aluminum, and of the pattern that has been adopted, with slight modifications, ever since Nansen made his famous journey in 1895-96. The sledging tents, of which I bought six, were made of light Willesden rot-proof drill, with a "spout" entrance of Burberry garberdine. They were green in color, as the shade is very restful to the eyes on the white snow plains, and weighed 27 pounds each, complete with five poles and floor cloth.

Each member of the expedition was supplied with two winter suits made of heavy blue pilot cloth, lined with Jaeger fleece. A suit consisted of a double-breasted jacket, vest and trousers, and weighed complete fourteen and three-quarter pounds.

An outer suit of wind-proof material is necessary in the polar regions, and I secured twenty-four suits of Burberry

THE PONY "QUAN" ABOUT TO DRAW A SLEDGE-LOAD OF STORES FROM THE ICE-FOOT TO THE HUT



DAY WITH THE MOTOR-CAR ON THE SEA ICE

garberdine, each suit consisting of a short blouse, trouser overalls, and a helmet cover.

For use in the winter quarters we took four dozen Jaeger camel's-hair blankets and sixteen camel's-hair triple sleeping bags.

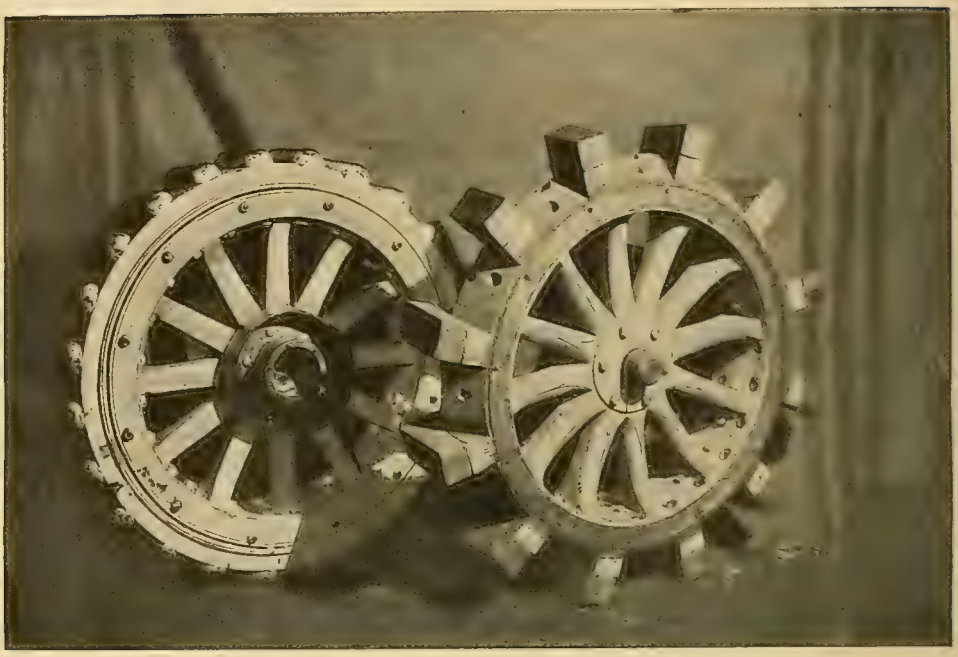
THE MANCHURIAN PONIES

I decided to take ponies, dogs, and a motor-car to assist in hauling our sledges on the long journeys that I had in view, but my hopes were based mainly on the ponies. Dogs had not proved satisfactory on the Barrier surface, and I did not expect my dogs to do as well as they actually did. The use of a motor-car was an experiment which I thought justified by my experience of the character of the Barrier surface, but I knew that it would not do to place much reliance on the machine in view of the uncertainty of the conditions. I felt confident, however, that the hardy ponies used in northern China and Manchuria would be useful if they could be landed on the ice in good condition.

I had seen these ponies in Shanghai, and I had heard of the good work they did on the Jackson-Harmsworth expedition. They are accustomed to hauling heavy loads in a very low temperature, and they are hardy, sure-footed, and plucky. I noticed that they had been used with success for very rough work during the Russo-Japanese war, and a friend who had lived in Siberia gave me some more information regarding their capabilities.

I therefore got into communication with the London manager of the Hongkong and Shanghai bank (Mr. C. S. Addis), and he was able to secure the services of a leading firm of veterinary surgeons in Shanghai. A qualified man went to Tientsin on my behalf, and from a mob of about two thousand of the ponies, brought down for sale from the northern regions, he selected fifteen of the little animals for my expedition.

The ponies chosen were all over twelve years and under seventeen years in age, and had spent the early part of their lives in the interior of Manchuria. They were



SPECIAL MOTOR WHEELS: THE ORIGINAL FORM ON THE LEFT, AN ANTARCTIC FORM ON RIGHT

Ordinary wheels with rubber tires were found to be the most satisfactory

practically unbroken, were about fourteen hands high, and were of various colors. They were all splendidly strong and healthy, full of tricks and wickedness, and ready for any amount of hard work over the snow-fields.

The fifteen ponies were taken to the coast and shipped by direct steamer to Australia. They came through the test of tropical temperatures unscathed, and at the end of October, 1907, arrived in Sydney, where they were met by Mr Reid and at once transferred to a New Zealand bound steamer. The Colonial governments kindly consented to suspend the quarantine restrictions, which would have entailed exposure to summer heat for many weeks, and thirty-five days after leaving China the ponies were landed on Quail Island, in Port Lyttelton, and were free to scamper about and feed in idle luxury.

I had secured in London twenty tons of maize and ten hundredweight of compressed Maujee ration for the feeding of the ponies in the Antarctic. The maize was packed in about seven hundred tin-lined air-tight cases, and the ration was in one-pound air-tight tins. This ration consists of dried beef, carrots, milk, currants and sugar, and it provides a large amount of nourishment with comparatively little weight. One pound of the ration will absorb four pounds of water, and the ponies were very fond of it. We also secured in Australia ten tons of compressed fodder, consisting of oats, bran, and chaff. This fodder was packed in two hundred and fifty small bales.

I placed little reliance on the dogs, as I have already stated, but I thought it advisable to take some of these animals. I knew that a breeder in Stewart Island, New Zealand, had dogs descended from the Siberian dogs used on the Newnes-Borchgrevinck expedition, and I cabled to him to supply as many as he could up to forty. He was only able to let me have nine, but this team proved quite sufficient for the purposes of the expedi-

A CLOUD EFFECT BEFORE THE SEA FROZE OVER

MUSIC IN THE HUT DURING THE WINTER

A MEMBER OF THE EXPEDITION TAKING HIS BATH

tion, as the arrival of pups brought the number up to twenty-two during the course of the work in the south.

THE SOUTH POLAR PARTY

Our party on leaving England consisted of:

E. H. Shackleton, commander.

Lieut. J. B. Adams, R. N. R., meteorologist.

Sir Philip Brocklehurst, Bart., assistant geologist and in charge of current observations.

Bernard Day, electrician and motor expert.

Ernest Joyce, in charge of general stores, dogs, sledges, and zoological collections.

Dr. A. F. Mackay, surgeon.

Dr. Eric Marshall, surgeon, cartographer.

G. E. Marston, artist.

James Murray, biologist.

Raymond Priestley, geologist.

William Roberts, cook.

Frank Wild, in charge of provisions.

Besides myself, Wild and Joyce only had had previous polar work, having been members of the *Discovery* expedition.

After the expedition had reached New Zealand and the generous assistance of the Australian and New Zealand governments had relieved me from some financial anxiety, I was able to add to the staff Douglas Mawson, lecturer of mineralogy and petrology at the Adelaide University, as physicist, and Bertram Armytage as a member of the expedition for general work; Prof. Edgeworth David, F. R. S., of Sydney University, as geologist and scientist; Leo Collon, a young Australian, and George Buckley, of New Zealand.

Our party found the hut which the *Discovery* party had abandoned at Cape Royds four years previously practically clear of snow, and the structure quite intact.

There was a small amount of ice inside on the walls, evidently the result of a summer thaw, but even after five years' desertion the building was in excellent

preservation. A few relics of the last expedition were lying about, including bags containing remnants of provisions from various sledging parties. Among these provisions was an open tin of tea, and the following morning the party made an excellent brew from the contents. It speaks volumes for the dryness of the climate that the tea should retain its flavor after exposure to the air for five years.

A sledging tin of petroleum was also used and was found to be in perfect condition. The ice on the end of Hut Point was cracked and crevassed, but in all other respects things seemed to be the same as when the *Discovery* steamed away to the north in February, 1904. The cross put up in memory of Vince, who lost his life close by in a blizzard, was still standing, and so were the magnetic huts.

EXPERIENCES WITH THE PENGUINS

One day we were pulling along at a good rate, landing stores, when suddenly a heavy body shot out of the water, struck the seaman who was pulling stroke, and dropped with a thud into the bottom of the boat. The arrival was an Adelie penguin. It was hard to say who was the most astonished—the penguin, at the result of its leap on to what it had doubtless thought was a rock, or we, who so suddenly took on board this curious passenger. The sailors in the boat looked upon this incident as an omen of good luck. There is a tradition among seamen that the souls of old sailors, after death, occupy the bodies of penguins, as well as of albatrosses; this idea, however, does not prevent the mariners from making a hearty meal off the breasts of the penguins when opportunity offers.

The penguins were round us in large numbers. We had not had any time to make observations of them, being so busily employed discharging the ship, but just at this particular time our attention was called to a couple of these birds which suddenly made a spring from the water and landed on their feet on the ice-edge, having cleared a vertical height of twelve feet. It seemed a marvelous jump for these small creatures to have made, and shows the rapidity with which they must move through the water to gain the impetus that enables them to clear a distance in vertical height four times greater than their own, and also how unerring must be their judgment in estimating the distance and height when performing this feat.

A blizzard interrupted the work of landing our supplies and buried everything under a thick mantle of snow.

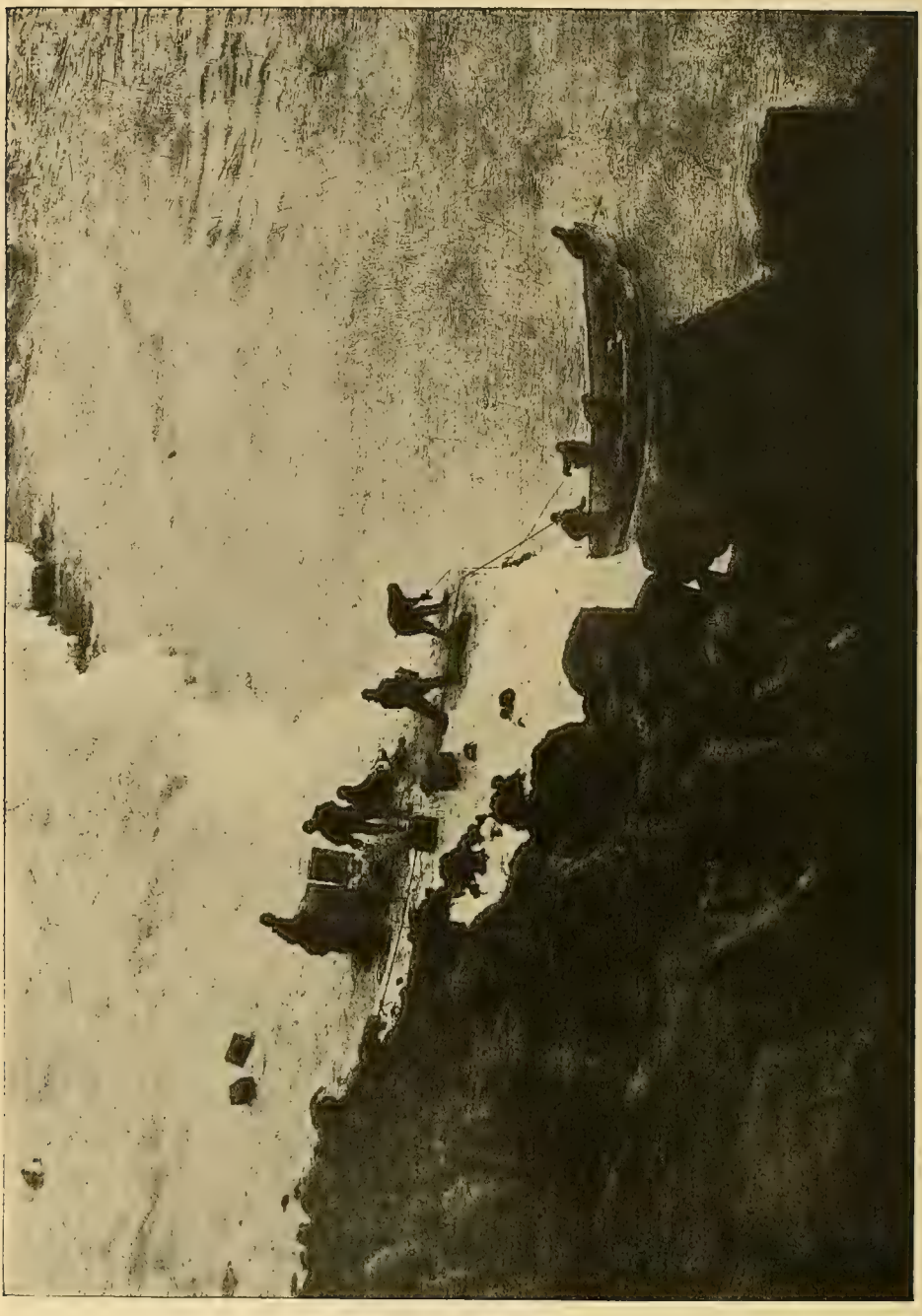
The next four or five days were spent in using pick and shovel and iron crowbars on the envelope of ice that covered our cases, corners of which only peeped out from the mass. The whole had the appearance of a piece of the sweet known as almond rock, and there was as much difficulty in getting the cases clear of the ice as would be experienced if one tried to separate almonds from that sticky conglomerate without injury. Occasionally the breaking out of a case would disclose another which could be easily extracted, but more often each case required the pick or crowbars. A couple of earnest miners might be seen delving and hewing the ice off a case, of which only the corner could be seen, and after ten minutes' hard work it would be hauled up, and the stenciled mark of its contents exposed to view.

Brocklehurst took great interest in the recovery of the chocolate, and during this work took charge of one particular case which had been covered by the ice. He carried it himself up to the hut so as to be sure of its safety, and he was greeted with joy by the Professor, who recognized in the load some of his scientific instruments which were playing the part of the cuckoo in an old chocolate box. Needless to say Brocklehurst's joy was not as heartfelt as the Professor's.

THE WINTER HOUSE BROUGHT FROM ENGLAND

Our winter headquarters was not a very spacious dwelling for the accommo-

FLIGHT OF ANTARCTIC PETRELS



LANDING STORES FROM THE BOAT AT THE FIRST LANDING PLACE AFTER THE ICE-FOOT HAD BROKEN AWAY

dation of fifteen persons, but our narrow quarters were warmer than if the hut had been larger.

The length inside was 33 feet, the breadth 19 feet, and the height to the eaves 8 feet. Between the outer wall and the inside lining of match-boarding, there was a space of about four inches, which was filled with granulated cork, serving to preserve the heat and keep out the cold. The outside was made of inch tongue-and-groove boarding, and a sloping roof, with a gable at each end and two ventilators, brought the total height up to 14 feet. The roof was double, but we did not fill the space between the two linings with cork, contenting ourselves with a double layer of felt over the outside roof, across which battens were nailed to protect the felt from the wind. While the felt was being nailed on, an Antarctic breeze came up, and some of the covering was stripped off. We found it hung up against rocks more than a mile away to the north, and eventually the work had to be done over again.

The first thing done was to peg out a space for each individual, and we saw that the best plan would be to have the space allotted in sections, allowing two persons to share one cubicle. This space for two men amounted to six feet six inches in length and seven feet in depth from the wall of the hut towards the center. There were seven of these cubicles, and a space for the leader of the expedition; thus providing for the fifteen who made up the shore party.

THE PONIES GET SICK

It seems to be generally assumed that a Manchurian pony can drag a sledge over a broken trail at the rate of 20 to 30 miles a day, pulling not less than 1,200 pounds. Some authorities even put the weight to be hauled at 1,800 pounds, but this is, I think, far too heavy a load. It was a risk to take ponies from the far north through the tropics and then across 2,000 miles of stormy sea on a very small ship, but I had felt that if it could be done it would be well worth the trouble, for, compared with the dog, the pony is a far more efficient animal, one pony doing the work of at least ten dogs on the food allowance for ten dogs, and traveling a longer distance in a day.

We established ourselves at the winter quarters with eight ponies, but unfortunately we lost four of them within a month of our arrival. The loss was due, in the case of three of the four, to the fact that they were picketed when they first landed on sandy ground, and it was not noticed that they were eating the sand. I had neglected to see that the animals had a supply of salt given to them, and as they found a saline flavor in the volcanic sand under their feet, due to the fact that the blizzards had sprayed all the land near the shore with sea water, they ate it at odd moments.

All the ponies seem to have done this, but some were more addicted to the habit than the others. Several of them became ill, and we were quite at a loss to account for the trouble until Sandy died. Then a post-mortem examination revealed the fact that his stomach contained many pounds of sand, and the cause of the illness of the other ponies became apparent. We shifted them at once from the place where they were picketed, so that they could get no more sand, and gave them what remedial treatment lay in our power, but two more died in spite of all our efforts.

EREBUS, THE SENTINEL OF THE GREAT ICE BARRIER

On coming out of the hut one had only to go round the corner of the building in order to catch a glimpse of Mount Erebus, which lay directly behind us. Its summit was about fourteen miles from our winter quarters, but its slopes and foothills commenced within three-quarters of a mile of the hut.

Standing as a sentinel at the gate of the Great Ice Barrier, Erebus forms a magnificent picture. The great mountain rises from sea-level to an altitude of over 13,000 feet, looking out across the Barrier, with its enormous snow-clad bulk towering above the white slopes that run up from the coast. At the top of the

mountain an immense depression marks the site of the old crater, and from the side of this rises the active cone, generally marked by steam or smoke. The ascent of such a mountain would be a matter of difficulty in any part of the world, hardly to be attempted without experienced guides, but the difficulties were accentuated by the latitude of Erebus.

The observer taking the meteorological observations every two hours had the mountain in sight, and as Erebus was our high-level meteorological observatory, to the crown of which we always looked for indications of wind-currents at that elevation, we naturally saw every phase of activity produced by the fires within. It was for this reason, no doubt, that during the period of our stay in these regions, more especially through the winter months, we were able to record a fairly constant condition of activity on the mountain. It became quite an ordinary thing to hear reports from men who had been outside during the winter that there was a "strong glow on Erebus." These glows at times were much more vivid than at others. On one particular occasion, when the barometer showed a period of extreme depression, the glow was much more active, waxing and waning at intervals of a quarter of an hour through the night, and at other times we have seen great bursts of flame crowning the crater.

The huge steam column that rises from the crater into the cold air shot up at times to a height of 3,000 or 4,000 feet before spreading out and receiving its line direction from the air-currents at that particular hour holding the upper atmosphere. There were occasions when the view of this steam cloud became much more vivid, and we found that the best view that could be obtained was when the moon, rising in the eastern sky, passed behind the summit of the mountain. Then, projected on the disc of the moon, we could see the great cloud traveling upward, not quietly, but impelled by force from below.

There were times also when it was obvious that the molten lava in the crater could not have been very far from the lip of the cup, for we could see the deep-red glow reflected strongly on the steam cloud. We often speculated as to the course the lava stream would take and its probable effect on the great glaciers and snow-fields flanking the sides of the mountain, should it ever overflow. These sudden uprushes were obviously the result of a vast steam explosion in the interior of the volcano and were sufficient proofs that Erebus still possesses considerable activity.

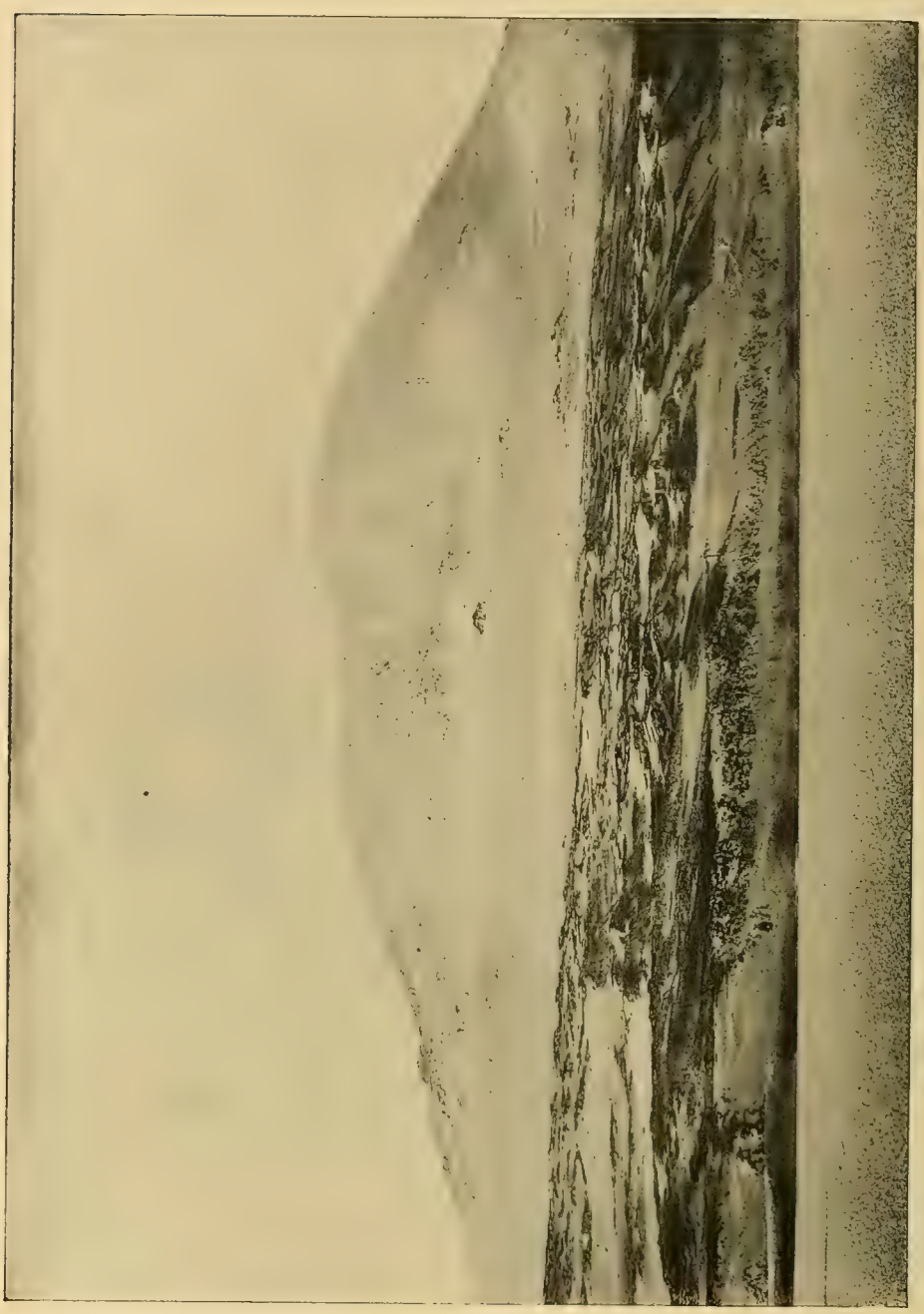
THE ASCENT OF EREBUS.

Before the winter set in, several members of the party climbed to the summit of Erebus. Their achievement will rank high among mountain climbs, for the party was compelled to endure temperatures of below zero, to fight through raging blizzards, and often the ascent was so steep as to be nearly insurmountable. From the summit they could look down into the fiery chasm of the volcano.

"We stood on the verge of a vast abyss, and at first could see neither to the bottom nor across it on account of the huge mass of steam filling the crater and soaring aloft in a column 500 to 1,000 feet high. After a continuous loud hissing sound, lasting for some minutes, there would come from below a big dull boom, and immediately great globular masses of steam would rush upward to swell the volume of the snow-white cloud which ever sways over the crater. This phenomenon recurred at intervals during the whole of our stay at the crater. Meanwhile, the air around us was extremely redolent of burning sulphur. Presently a pleasant northerly breeze fanned away the steam cloud, and at once the whole crater stood revealed to us in all its vast extent and depth.

"Mawson's angular measurement made the depth 900 feet and the greatest width about half a mile. There were at least three well-defined openings at the bottom of the cauldron, and it was from these that the steam explosions pro-

MOUNT EREBUS FROM THE ICE-FOOT



MOUNT EREBUS AS SEEN FROM THE WINTER QUARTERS, THE OLD CRATER ON THE LEFT, AND THE ACTIVE CONE RISING ON THE RIGHT

ceeded. Near the southwest portion of the crater there was an immense rib in the rim, perhaps 300 to 400 feet deep. The crater wall opposite the one at the top of which we were standing presented features of special interest. Beds of dark pumiceous lava or pumice alternated with white zones of snow. There was no direct evidence that the snow was bedded with the lava, though it was possible that such may have been the case. From the top of one of the thickest of the lava or pumice beds, just where it touched the belt of snow, there rose scores of small steam jets all in a row. They were too numerous and too close together to have been each an independent fumarole; the appearance was rather suggestive of the snow being converted into steam by the heat of the layer of rock immediately below it."

Two features of the geology of Erebus which are specially distinctive are the vast quantities of large and perfect feldspar crystals and the ice fumaroles. The crystals are from two to three inches in length. Many of them have had their angles and edges slightly rounded by attrition, through clashing against one another when they were originally projected from the funnel of the volcano, but numbers of them are beautifully perfect. The fluid lava which once surrounded them has been blown away in the form of fine dust by the force of steam explosions, and the crystals have been left behind intact.

The ice fumaroles are specially remarkable. About fifty of these were visible to us on the track which we followed to and from the crater, and doubtless there were numbers that we did not see. These unique ice-mounds have resulted from the condensation of vapor around the orifices of the fumaroles. It is only under conditions of very low temperature that such structures could exist. No structures like them are known in any other part of the world.

LIFE DISCOVERED IN THE ICE DURING THE WINTER

On March 13 we experienced a very fierce blizzard. The hut shook and rocked in spite of our sheltered position, and articles that we had left lying loose outside were scattered far and wide. Even cases weighing from 50 to 80 pounds were shifted from where they had been resting, showing the enormous velocity of the wind. When the gale was over we put everything that was likely to blow away into positions of greater safety.

It was on this day also that Murray found living microscopical animals on some fungus that had been thawed out from a lump of ice taken from the bottom of one of the lakes. This was one of the most interesting biological discoveries that had been made in the Antarctic, for the study of these minute creatures occupied our biologist for a great part of his stay in the south, and threw a new light on the capability of life to exist under conditions of extreme cold and in the face of great variations of temperature.

We all became vastly interested in the rotifers during our stay, and the work of the biologist in this respect was watched with keen attention. From our point of view there was an element of humor in the endeavors of Murray to slay the little animals he had found. He used to thaw them out from a block of ice, freeze them up again, and repeat this process several times without producing any result as far as the rotifers were concerned. Then he tested them in brine so strongly saline that it would not freeze at a temperature above minus 7° Fahr., and still the animals lived. A good proportion of them survived a temperature of 200° Fahr. It became a contest between rotifers and scientist, and generally the rotifers seemed to triumph.

THE SOUTHERN PARTY

The southern party, consisting of Shackleton, Adams, Marshall, and Wild, left the winter quarters October 29, 1908, and for five weeks headed up the Ice Barrier.

On November 26 we camped in latitude 82° 18½′ south, longitude 168° east, having passed the "furthest south"

THE CAMP 7,000 FEET UP MOUNT EREBUS: THE STEAM FROM THE ACTIVE CRATER CAN BE SEEN

BROCKLEHURST LOOKING DOWN FROM A POINT 9,000 FEET UP MOUNT EREBUS: THE CLOUDS LIE BELOW, AND CAPE ROYDS CAN BE SEEN

ONE THOUSAND FEET BELOW THE ACTIVE CONE OF MOUNT EREBUS

THE CRATER OF EREBUS, 900 FEET DEEP AND HALF A MILE WIDE: STEAM IS SEEN RISING ON THE LEFT

The photograph was taken from the lower part of the crater edge

A REMARKABLE FUMAROLE IN THE OLD CRATER, IN THE FORM OF A COUCHANT LION: THE MEN (FROM THE LEFT) ARE: MACKAY, DAVID, ADAMS, MARSHALL

SKUA GULLS FEEDING NEAR THE HUT AT CAPE ROYDS

record. New land had come within our range of vision by this time, owing to the fact that we were far out from the base of the mountains, and I had noted with some anxiety that the coast trended south-southeast, thus threatening to cross our path and obstruct the way to the pole. We could see great snow-clad mountains rising beyond Mount Longstaff, and also far inland to the north of Mount Markham. On November 26 we opened out Shackleton Inlet, and looking up it sighted a great chain of mountains, while to the west of Cape Wilson appeared another chain of sharp peaks, about 10,000 feet high, stretching away to the north beyond Snow Cape, and continuing the land on which Mount A. Markham lies.

The first pony had been killed on November 21, when we were south of the 81st parallel, and we had left a depot of pony meat and ordinary stores, to provide for the return march. We started at once to use pony meat as part of the daily ration, and soon found that scraps of raw, frozen meat were of assistance on the march in maintaining our strength and cooling our parched throats. A second pony was shot on November 28, and a third on December 1, by which time we were closing in on the land, and it had become apparent that we would have to find a way over the mountains if we were to continue the southern march.

We were still sighting new land ahead, and the coast line had a more distinct easterly trend. We camped on December 2 in latitude 83° 28′ south, longitude 171° 30′ east, opposite a red granite mountain about 3,000 feet in height. On the following day we climbed this mountain, and from its summit saw an enormous glacier, stretching almost due south, flanked by huge mountains, and issuing on to the Barrier south of our camp. We decided at once that we had better ascend the glacier, and on the following day made our way, with two sledges and the last pony, on to its surface.

DERRICK POINT, SHOWING THE METHOD OF HAULING STORES UP THE CLIFF

ASCENDING A GLACIER WHICH WAS 130 MILES IN LENGTH

We encountered difficulties at once, for the snow-slopes by means of which we gained the glacier surface gave way to blue ice, with numberless cracks and crevasses, many of them razor-edged. Traveling on this surface in finnesko was slow and painful work.

On December 5 Marshall and Adams, who were ahead looking for a route, reported that at a point close to the granite cliffs a bird, brown in color, with a white line under each wing, had flown over their heads. They were sure it was not a skua gull, the only bird likely to have been attracted by the last dead pony. It was a curious incident to occur in latitude 83° 40′ south. We left the fourth depot close to the foot of the glacier at the foot of a wonderful granite cliff, polished by the winds and snows of ages. On December 6 we took six hours to pass about 600 yards of severely crevassed ice, over which all our gear had to be relayed, and on the following day we lost the last pony, which fell into a crevasse disguised, like so many others, by a treacherous snow-lid. Wild was leading the pony with one sledge, while Adams, Marshall, and myself went on ahead with the other sledge and pioneered a practical path. We had passed over a snow-covered crevasse without noticing it, but the greater weight of the pony broke through the lid, and the animal dropped through, probably to a depth of several hundreds of feet. Happily the swingle-tree snapped with a sudden strain, and Wild and the sledge were saved. This accident left us with two sledges and a weight of about 250 pounds per man to haul. Our altitude at this time was about 1,700 feet above sea-level.

During the days that followed we made steady progress up the glacier, experiencing constant difficulty with the crevasses. We hauled well ahead of the sledges, so that when one of us dropped through a snow-lid the harness would support him until he could be hauled up again. We had many painful falls as a result of having no footgear suitable for the ice-climbing, and any future travelers would do well to take boots with spikes. A special form would have to be devised, on account of the low temperature rendering impracticable the use of ordinary mountaineering boots.

COAL AND FOSSIL WOOD DISCOVERED

New land appeared day after day, and we were able to make small geological collections and to take some photographs. The rocks were sedimentary, the lines of stratification often showing clearly on the mountain sides, and we made two geological discoveries of the first importance. In latitude 85° south, Wild, who had climbed the slope of a mountain in

order to look ahead, found coal, six seams ranging from 4 inches to 7 or 8 feet in thickness, with sandstone intervening. Close to this point I found a piece of sandstone showing an impression, and microscopic investigation has shown that this was fossil coniferous wood.

The glacier proved to be about 130 miles in length, rising to an altitude of over 9,000 feet. Christmas day, 1908, found us in latitude 85° 55′ south, a plateau with ice-falls appearing to the south. Much glaciated land trended to the southeast, apparently ending in a high mountain shaped like a keep. The land to the west had been left behind. It was evident that we were still below the plateau level, and, though we were getting free of crevasses, we were hindered by much soft snow. The level was rising in a series of steep ridges about 7 miles apart. We had started to reduce rations before leaving the Barrier surface, and by Christmas day were marching on very short commons. Our temperature was 2° subnormal, but otherwise we were well and fit.

On December 31 we camped in latitude 86° 54′ south. We had not yet reached the plateau level, for slopes still lay ahead, and our altitude was about 10,000 feet. We had three weeks' food on a reduced ration, and were 186 geographical miles from the pole. The land had been left behind, and we were traveling over a white expanse of snow, still with rising slopes ahead. We were weakening from the combined effects of short food, low temperature, high altitude, and heavy work. We were able to march on the first six days of January, and on the night of January 6 camped in latitude 88° 7′ south. We had increased the daily ration, for it had become evident that vitality could not be maintained on the amount of food we had been taking. I had been forced to abandon the hope of reaching the pole, and we were concentrating our efforts on getting within 100 miles of the goal.

CAUGHT IN A BLIZZARD

A fierce blizzard blew on January 7 and 8, and made any march impossible. We lay in our sleeping bags, frequently attacked by frost-bite. The following paragraphs are quoted from my diary.

"January 7.—A blinding, shrieking blizzard all day, with the temperature ranging from 60° to 70° of frost. It has been impossible to leave the tent, which is snowed up on the lee side. We have been lying in our bags all day, only warm at food time, with fine snow making through the walls of the worn tent and covering our bags. We are greatly cramped. Adams is suffering from cramp every now and then. We are eating our valuable food without marching.

The wind has been blowing 80 to 90 miles an hour. We can hardly sleep. Tomorrow I trust this will be over. Directly the wind drops we march as far south as possible, then plant the flag and turn homeward. Our chief anxiety is that our tracks may drift up, for to them we must trust mainly to find our depot; we have no land bearings in this great plain of snow. It is a serious risk that we have taken, but we had to play the game to the utmost, and Providence will look after us.

January 8.—Again all day in our bags, suffering considerably physically from cold hands and feet and from hunger, but more mentally, for we cannot get on south, and we simply lie here shivering. Every now and then one of our party's feet go, and the unfortunate beggar has to take his leg out of the sleeping bag and have his frozen foot nursed into life again by placing it inside the shirt, against the skin, of his almost equally unfortunate neighbor.

We must do something more to the south, even though the food is going, and we weaken lying in the cold, for with 72° of frost the wind cuts through our thin tent, and even the drift is finding its way in and on to our bags, which are wet enough as it is. Cramp is not uncommon every now and then, and the

PORTAGING THE SLEDGE OVER A PATCH OF BARE ROCK

drift all round the tent has made it so small that there is hardly room for us at all. The wind has been blowing hard all day; some of the gusts must be over 70 or 80 miles an hour.

This evening it seems as though it were going to ease down, and directly it does we shall be up and away south for a rush. I feel that this march must be our limit. We are so short of food, and at this high altitude, 11,600 feet, it is hard to keep any warmth in our bodies between the scanty meals. We have nothing to read now, having depoted our little books to save weight, and it is dreary work lying in the tent with nothing to read, and too cold to write much in the diary.

110 MILES FROM THE SOUTH POLE

January 9.—Our last day outward. We have shot our bolt, and the tale is latitude 88° 23′ south, longitude 162° east. The wind eased down at 1 a. m., and at 2 a. m. we were up and had breakfast. At 4 a. m. we started south, with the Queen's Union Jack, a brass cylinder containing stamps and documents to place at the farthest south point, camera, glasses, and compass. At 9 a. m. we were in 88° 23′ south, half running and half walking over a surface much hardened by the recent blizzard. It was strange for us to go along without the nightmare of a sledge dragging behind us.

We hoisted her Majesty's flag and the other Union Jack afterwards, and took possession of the plateau in the name of his Majesty. While the Union Jack blew out stiffly in the icy gale that cut us to the bone, we looked south with our powerful glasses, but could see nothing but the dead white snow plain. There was no break in the plateau as it extended toward the pole, and we feel sure that the goal we have failed to reach lies on this plain.

We stayed only a few minutes, and then, taking the Queen's flag and eating our scanty meal as we went, we hurried back and reached our camp about 3 p. m.

SLEDGING ON THE BARRIER BEFORE THE RETURN OF THE SUN: MOUNT EREBUS IN THE BACKGROUND. TEMPERATURE, 58° FAHRENHEIT BELOW ZERO

AN ICE CAVERN IN THE WINTER: PHOTOGRAPHED BY THE LIGHT OF HURRICANE LAMPS

We were so dead tired that we only did an hour's march in the afternoon and camped at 5 p. m. The temperature was minus 19° Fahr. Fortunately for us, our tracks were not obliterated by the blizzard; indeed, they stood up, making a trail easily followed. Homeward bound at last. Whatever regrets may be, we have done our best."

THE HOMEWARD MARCH

The homeward march was rendered difficult by shortage of food and attacks of dysentery due to the meat from one of the ponies.

We had a strong wind behind us day after day during this period, and this contributed in a very large measure to our safety, for in the weakened condition we had then reached we could not have made long marches against a head wind, and without long marches we would have starved between the depots. We had a sail on the sledge, formed of the floor cloth of a tent, and often the sledge would overrun us, though at other times it would catch in a drift and throw us heavily.

The results of the southern journey may be summarized briefly. We found that a chain of great mountains stretched north by east from Mount Markham as far as the 86th parallel, and that other ranges ran toward the southwest, south, and southeast between the 84th and the 86th parallels. We ascended one of the largest glaciers in the world on to a high plateau, which in all probability is a continuation of the Victoria Land plateau. The geographical pole almost certainly lies on this plateau, at an altitude of between 10,000 and 11,000 feet above sea-level. The discovery of coal and fossil wood has a very important bearing on the question of the past geological history of the Antarctic continent.

FROSTBITE AND SUNBURN AT THE SAME TIME

When we were traveling along during the early part of the journey over the level Barrier surface, we felt the heat of the sun severely, though as a matter of fact the temperature was generally very low, sometimes as low as zero Fahr., though the season was the height of summer. It was quite usual to feel one side of the face getting frozen while the other side was being sunburned. The ponies would have frozen perspiration on their coats on the sheltered side, while the sun would keep the other side hot and dry, and as the day wore on and the sun moved round the sky the frosted area on the animals would change its position in sympathy.

I remember that on December 4 we were marching stripped to our shirts, and we got very much sunburned, though at noon that day the air temperature showed ten degrees of frost. When we started to climb the glacier and marched close to the rocks, we felt the heat much more, for the rocks acted as radiators, and this experience weighed with me in deciding to leave all the spare clothing and equipment at the Upper Glacier depot, about 7,000 feet up. We did not expect to have to climb much higher, but we did not reach the plateau until we had climbed over 10,000 feet above sea-level, and so we felt the cold extremely. Our wind-proof Burberry clothing had become thin by this time, and had been patched in many places in consequence of having been torn on the sharp ice.

The wind got in through a tear in my Burberry trousers one day and I was frost-bitten on the under part of the knee. This frost-bite developed into an open wound, into which the wool from my underclothing worked, and I had finally to perform a rather painful operation with a knife before the wound would heal. We were continually being frost-bitten up on the plateau, and when our boots had begun to give out and we were practically marching on the sennegrass inside the finnesko our heels got frost-bitten. My heels burst when we got on to hard stuff, and for some time my socks were caked with blood at the end of every day's march. Finally Marshall put some "newskin" on a pad, and that stuck on well until the cracks had healed. The scars are likely to remain with me.

AN ICE CAVE IN THE WINTER

In the very cold days, when our strength had begun to decrease, we found great difficulty in hoisting the sail on our sledge, for when we lifted our arms above our heads in order to adjust the sail the blood ran from our fingers and they promptly froze. Ten minutes or a quarter of an hour sometimes elapsed before we could get the sledge properly rigged. Our troubles with frost-bite were no doubt due in a measure to the lightness of our clothing, but there was compensation in the speed with which we were able to travel. I have no doubt at all that men engaged in polar exploration should be clothed as lightly as is possible, even if there is a danger of frost-bite when they halt on the march.

We would certainly not have traveled so fast had we been wearing the regulation pilot-cloth garment generally used in polar exploration. Our experience made it obvious that a party which hopes to reach the pole must take more food per man than we did, but how the additional weight is to be provided for is a matter of individual consideration. I would not take cheese again, for although it is a good food, we did not find it as palatable as chocolate, which is practically as sustaining. Our other foods were all entirely satisfactory.

THE DIVISION OF WORK

Each member of the southern party had his own particular duties to perform. Adams had charge of the meteorology, and his work involved the taking of temperatures at regular intervals, and the boiling of the hypsometer, sometimes several times in a day. He took notes during the day, and wrote up the observations at night in the sleeping bag. Marshall was the cosmographer and took the angles and bearings of all the new land; he also took the meridian altitudes and the compass variations as we went south. When a meridian altitude was taken, I generally had it checked by each member of the party, so that the mean could be taken.

Marshall's work was about the most uncomfortable possible, for at the end of a day's march, and often at lunch-time, he would have to stand in the biting wind handling the screws of the theodolite. The map of the journey was prepared by Marshall, who also took most of the photographs. Wild attended to the repair of the sledges and equipment, and also assisted me in the geological observations and the collection of specimens. It was he who found the coal close to the Upper Glacier depot. I kept the courses and distances, worked out observations, and laid down our directions. We all kept diaries. I had two, one my observation book and the other the narrative diary, reproduced in the first volume.

To the biologist, no more uninviting desert is imaginable than Cape Royds seemed when we made our first landing, and for long afterwards. Here is absolute desolation, a black and white wilderness, rugged ridges of lava alternating with snowdrifts for a few miles, ending to the north and south in crevassed glaciers, and eastward in the snow-field stretching up to the rocky crags of the cone of Mount Erebus.

On the very edge of the sea, the little colony of Adelie penguins and the scattered skua gulls relieved the monotony. Beyond was no living creature, no blade of grass, or tiniest patch of welcome green.

Bleak and bare though it was, this stretch of two or three miles of broken country, where rocky peaks and ridges, moraines and snow drifts diversified the surface, was the field of operations for the biologist. The white waste of glacier and snow-field was hopeless; the nearer country seemed little more promising.

The sea was there known to be teeming with varied life, but it was inaccessible till the ice should bridge it over.

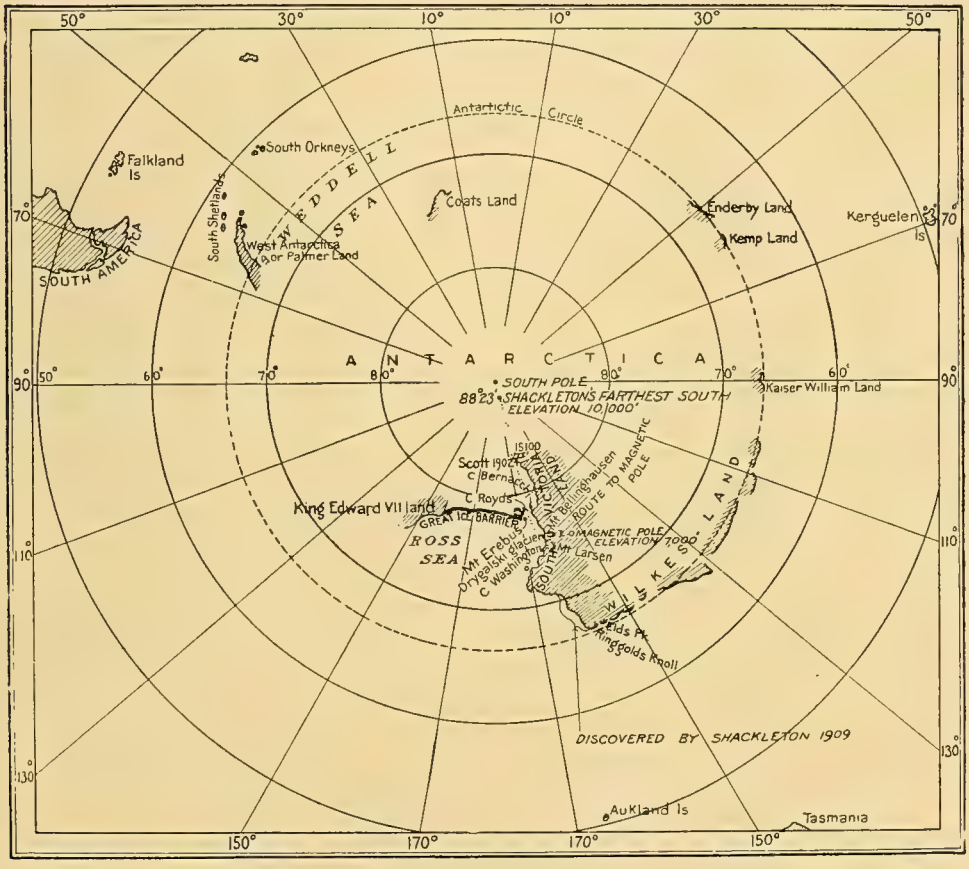
Water-bears were found to live while frozen in ice just as well as the rotifers did. It is an interesting fact that the only abundant species at Cape Royds is an Arctic species (*Macrobiotus arcticus*) which was only previously known in Spitzbergen and Franz Josef Land, and which has not yet been detected in the various collections made on the other

ICE FLOWERS ON NEWLY FORMED SEA ICE EARLY IN THE WINTER

side of the Antarctic by Bruce's and Nordenskjold's expeditions.

The mystery of the Great Ice Barrier has not been solved, and it would seem that the question of its formation and extent cannot be determined definitely until an expedition traces the line of the mountains round its southerly edge. A certain amount of light has been thrown on the construction of the Barrier, in that we were able, from observations and measurements, to conclude provisionally that it is composed mainly of snow. The Barrier still continues its recession, which has been observed since the voyage of Sir James Ross in 1842. There certainly appears to be a high snow-covered land on the 163d meridian, where we saw slopes and peaks, entirely snow covered, rising to a height of 800 feet, but we did not see any bare rocks, and did not have an opportunity to take soundings at this spot. We could not arrive at any definite conclusion on the point.

The journey made by the northern party resulted in the attainment of the South Magnetic Pole, the position of which was fixed, by observations made on the spot and in the neighborhood, at latitude 72° 25′ south, longitude 155° 16′ east. The first part of this journey was made along the coast-line of Victoria Land, and many new peaks, glaciers and ice-tongues were discovered, in addition to a couple of small islands. The whole of the coast traversed was carefully triangulated, and the existing map was corrected in several respects.



OUTLINE MAP OF SOUTH POLAR REGIONS

MRS GARDINER GREENE HUBBARD

Tribute of Respect to the Memory of Mrs Gardiner Greene Hubbard adopted by the Board of Managers of the National Geographic Society at a special meeting held at Hubbard Memorial Hall October 23, 1909.

THE death of Mrs Gardiner Greene Hubbard is to the National Geographic Society a great, an irreparable, loss, and to each member of the Board of Managers comes as a personal bereavement. Her broad and constant interest in the work of the Society, apparent during the decade in which her husband, Gardiner Greene Hubbard, served as its President, has since his death on December 11, 1907, been its greatest stimulus to renewed activity in the work to which he devoted so many years, and for the conduct of which he, twenty-one years ago, became the Society's first President. Her personal interest in its work in behalf of scientific geography and diffusion of geographic information among the people, her attendance upon its public meetings during the long years of its activities, and her individual recognition of the work performed by others in its behalf have been an inspiration to the officers of this Society, the members of the Board of Managers, the speaker upon the platform, and the editor at his desk, while her splendid gift of a building which became at once a home for the Society and a memorial to its founder and first President, now becomes of added interest as a memorial of her own generosity and a practical aid in the diffusion of information to all parts of the country and to all quarters of the world.

THE NORTH POLE

THE Board of Managers of the National Geographic Society, at a meeting held at Hubbard Memorial Hall November 4, 1909, received the following report:

The sub-committee to which was referred the task of examining the records of Commander Peary in evidence of his having reached the North Pole, beg to report that they have completed their task.

Commander Peary has submitted to this sub-committee his original journal and records of observations, together with all his instruments and apparatus, and certain of the most important of the scientific results of his expedition. These have been carefully examined by your sub-committee, and they are unanimously of the opinion that Commander Peary reached the North Pole on April 6, 1909.

They also feel warranted in stating that the organization, planning, and management of the expedition, its complete success, and its scientific results, reflect the greatest credit on the ability of Commander Robert E. Peary, and render him worthy of the highest honors that the National Geographic Society can bestow upon him.

HENRY GANNETT.
C. M. CHESTER.
O. H. TITTMANN.

The foregoing report was unanimously approved.

Immediately after this action the following resolutions were unanimously adopted:

WHEREAS, Commander Robert E. Peary has reached the North Pole, the goal sought for centuries,

WHEREAS, This is the greatest geographical achievement that this Society can have opportunity to honor, therefore

Resolved, That a special medal be awarded to Commander Peary.

Resolved, That the question of whether or not any one reached the North Pole prior to 1909 be referred to the Committee on Research with instructions to recommend to the Board of Managers a sub-committee of experts who shall have authority to send for papers or make such journeys as may be necessary to inspect original records, and that this action of the Society be communicated at once to those who may have evidence of importance.

Resolved, That in view of the able seamanship, pertinacious effort, and able management of Captain C. A. Bartlett, displayed during the Peary Arctic Expedition of 1908-1909, and that he reached the high latitude of 87° 40′ north, he be awarded a medal by the National Geographic Society.

At a meeting of the Board of Managers November 8, the Committee on Research of the Society recommended that the personnel of the committee to consider whether the pole was discovered before 1909 should be entirely different from that of the committee which passed on the Peary records. Upon their recommendation the Board appointed the following committee:

J. Howard Gore, formerly Professor of Mathematics, George Washington University, and author of several works on surveying and geodesy.

Rear Admiral John E. Pillsbury, U. S. N., who was for ten years in charge of the hydrographic office of the U. S. Navy, did important work investigating the gulf stream currents, was for several years Assistant Chief of the Bureau of Navigation of the Navy Department, and later Chief of Staff of the North Atlantic Squadron.

Dr C. Willard Hayes, Chief Geologist of the U. S. Geological Survey, one of the pioneer explorers of Alaska and of many sections of the Rocky Mountains.

PROGRAM OF MEETINGS OF THE NATIONAL GEOGRAPHIC SOCIETY 1909-10

Friday, 8.15 p. m., November 12—"The North Pole." Commander Robert E. Peary, U. S. Navy. Illustrated.

Friday, 8.15 p. m., November 19—"In Savage New Guinea." Mr Thomas Barbour, of Harvard University. An account of the strange people and extraordinary scenery of this little-known island by the author of the two fascinating articles, "Notes on New Guinea," recently published in the NATIONAL GEOGRAPHIC MAGAZINE. Illustrated.

Friday, 8.15 p. m., November 26—"A Rollicking Ramble in Ireland." Mr Seumas McManus, author of "A Lad of the O'Friel's," "Through the Turf Smoke," "Donegal Fairy Stories," "Ballads of a Country Boy," etc. Illustrated.

Friday, 8.15 p. m., December 3—"Children of Many Lands." Mr O. P. Austin, Secretary of the National Geographic Society and Chief of the U. S. Bureau of Statistics. Illustrated.

Friday, 8.15 p. m., December 10—"Spain and Her People." Dr Charles Upson Clark, of Yale University. The speaker will describe the romance and grandeur and present conditions in the country. Illustrated.

Wednesday, 7.30 p. m., December 15—Annual Banquet.

Friday, 8.15 p. m., December 17—"The Untamed Girdle of Palestine." Mr Ellsworth Huntington, of Yale University. A two weeks' expedition on the Dead Sea with a canvas boat, a trip to the famous Rock City of Petra, by way of the desolate Ghor, and an excursion to the little-known Negen, south of Beersheba. Illustrated.

Friday, 8.15 p. m., January 7—"Manchuria; the Antung Mukden Railway; the funeral of the late Empress Dowager, November 9, 1909." Miss Eliza R. Scidmore, author of "China—the Long Lived Empire," "Jinrikisha Days in Japan," etc. Illustrated.

Friday, 8.15 p. m., January 14—(The subject will be announced later.) Mr John Barrett, Director International Bureau of American Republics. Illustrated.

Friday, 8.15 p. m., January 21—"The Life of the Nest; Studies of the Nesting Habit of Birds." Frank M. Chapman, author of "Camps and Cruises of an Ornithologist," "Bird Studies with a Camera," etc. Illustrated.

Friday, 8.15 p. m., January 28—"The Ottoman Empire." Rear Admiral Colby M. Chester, U. S. Navy. From June, 1908, to May, 1909, inclusive, Admiral Chester lived in Constantinople or was traveling throughout Asia Minor. He was thus a witness of the revolution and of the beginning of the new era in Turkey. Illustrated.

Friday, 8.15 p. m., February 4—"Mountaineering in a New Switzerland." Professor

Charles E. Fay, of Tufts College, formerly President American Alpine Club. Illustrated by personal experiences and views gathered during sixteen seasons passed by the lecturer in the Canadian Rockies and Selkirks.

Friday, 8.15 p. m., February 11—"The Waterways of Empire." Mr Willis Fletcher Johnson, Associate Editor of New York Tribune. An account of the part which rivers, canals, and other narrow waterways have played in the political and commercial history of the world, and especially of this country. Illustrated.

Friday, 8.15 p. m., February 18—"The Glaciers of Alaska; an Account of the National Geographic Society Expedition to Alaska in 1909." Professor Lawrence F. Martin, of the University of Wisconsin, and, with Professor Ralph S. Tarr, of Cornell University, leader of the Society's Expedition. Illustrated.

Friday, 8.15 p. m., February 25—"The Panama Canal." It is hoped that official duties will permit Colonel George W. Goethals, Chief Engineer of the Panama Canal, to accept the invitation of the National Geographic Society to address the Asociation on this subject.

Friday, 8.15 p. m., March 4—"Physical Problems of Our Country." Mr Gifford Pinchot, Chief of the U. S. Forest Service. Illustrated.

Friday, 8.15 p. m., March 11—"The Waste of Human Life and Resources in the Mining Industry." Mr Joseph A. Holmes, of the U. S. Geological Survey. Dr Holmes will tell of the Government's efforts to stem the tide of fatalities in which the United States leads the world at a ratio of three to one and the Government's efforts to devise ways of saving the great waste not only of human life but of our coal, gas, and other mineral resources. Illustrated.

Friday, 8.15 p. m., March 18—"A New Era for the South." Dr Charles W. Stiles. The speaker will describe the methods by which science and money hope to eradicate the hookworm or "lazygerm."

Friday, 8.15 p. m., March 25—"The Spirit of the West." Mr C. J. Blanchard, of the U. S. Reclamation Service. The wonderful agricultural development of the West since the work of irrigation was started by the Government and private enterprise. Illustrated and moving pictures.

Friday, 8.15 p. m., April 1—"Patagonia to Paraguay—or the Story of Argentine." Mrs Harriet Chalmers Adams. Illustrated.

Friday, 8.15 p. m., April 8—"The Pearl Fisheries of Ceylon." Dr Hugh M. Smith, Deputy Commissioner, U. S. Bureau of Fisheries. Illustrated.

Friday, 8.15 p. m., April 15—"Nearest the South Pole." Lieutenant E. H. Shackleton. Illustrated.

THE NATIONAL GEOGRAPHIC MAGAZINE

THE ROUTE OVER WHICH MOSES LED THE CHILDREN OF ISRAEL OUT OF EGYPT

BY FRANKLIN E. HOSKINS, OF BEIRUT, SYRIA

With Photographs by the Author

A FEW years ago a young woman about to visit the Holy Land called on an old lady friend who loved her Bible and read it frequently from beginning to end, and told her that she soon hoped to see Jerusalem, Bethlehem, Galilee, and all the places associated with the life of Christ. The old lady put down her work, removed her silver-rimmed spectacles, and exclaimed: "Well now! I knew all those places were in the Bible, but I never thought of their being on the earth!"

It may therefore interest many of the readers of this Magazine to know that the Desert of the Exodus has an actual existence upon the face of the earth, and that the route of the Exodus is being mapped and studied and photographed by enthusiastic scholars and travelers with results as interesting and as brilliant in their way as attended the modern exploration of the Holy Land and Egypt.

It brings the doings of the Children of Israel in the Pentateuch much closer to modern life when we realize that the route of the Exodus is cut in its first section by the Suez Canal, one of the greatest enterprises on our planet, and that the Mecca Pilgrimage Railway follows that route in its upper stretches from a point near the Red Sea, Zalmoneh, northward for more than 100 miles through Edom and Moab, and again from Rabbath Ammon another 62 miles to Edrei, once the capital of Og, King of Bashan (Numbers 21:33), but now a railroad center where the three lines, from the seacoast at Carmel, from Damascus, and from Mecca meet.

Many will be surprised to learn that a telegraph wire now stretches through the desert from Suez to Tor, a little port just below Mount Sinai; that another wire connects Damascus via Maan with Akaba opposite Ezion-geber on the Red Sea; that a steam launch now navigates the Dead Sea and the Jordan River below Jericho, and that Thomas Cook & Son have added "Sinai and the Desert of the Exodus, Edom, and Moab" to their wall signs and tourist routes.

A DAY FOR EACH YEAR OF THE EXODUS

It has just been the great privilege of the writer, in company with Dr John F. Goucher, of the Woman's College of Baltimore, and Mr S. Earl Taylor, of New York, to follow the route of the Children of Israel from Egypt through the Sinaitic

Peninsula, Mount Seir, Edom and Moab, Amman and the Jabbok, to the Jordan and Jericho. It was a journey of about a thousand miles on camels and horses, and occupied about 40 days—a day for each year of the Exodus. We camped literally within the Old Testament, pitching our tents 32 times between the Nile and the Jordan. It was a physical review of some of the greatest events and characters in human history.

There was a strange thrill in dating letters from "The Jabbok (Gen. 32:22)," where Jacob wrestled with the angel; from "The Nile (Gen. 41:1)," where Joseph first came into contact with Pharaoh; from "Sinai (Exodus 33:11)," where Jehovah spake with Moses face to face, and from "Nebo (Deut. 34:6)," in the land of Moab, where Moses had his only view of the Promised Land, and where "the angels of God upturned the sod for that lonely and unknown grave." While it cannot be insisted too sharply that the Exodus is no imaginary journey, there is a sense in which the old lady was right, for so many of these events and places belong to the geography of the human soul in its exile, its bondage, its wanderings, its glimpses of the Promised Land, and its return to home and heaven at last.

Crossing the Suez arm of the Red Sea and journeying "three days in the wilderness," we spent a quiet Sabbath among "the palms of Elim" and drank from its "springs of water." Another six days' journey carried us along "by the Red Sea," through "the wilderness of sin," past Rephidim to Mount Sinai, on whose sublime summits we spent a part of our second Sabbath. Another five camps carried us down from Sinai past Hazeroth, through the "wilderness of Paran," and well up along the coast of the Gulf of Akaba to Elath and Ezion-geber.

Crossing the great cleft of the Araba south of the Dead Sea, we climbed into the mountains of Edom and from the summit of the traditional Mount Hor had, like Aaron, our first glimpse of the Promised Land. Then followed a series of camps by the Arnon, along the breezy plateaus of Moab, culminating in a never-to-be-forgotten Sabbath on Nebo itself, with its matchless view embracing so much of all succeeding Bible history, not forgetting Greece and Rome and the empires lasting till the present hour.

For over against the sky-line, neglecting every other feature in the wide expanse as seen from Nebo, rises the Mount of Olives, where Russia, Austria, Germany, and the other Christian nations of the West are still striving for possession of the Promised Land, while the real owners, the Jews, are scattered over the face of the earth. It is a small and unimportant-looking land upon a map of the world, and yet so great in human history. After Nebo came some lovely camps by the quiet waters of the Jabbok, among the woody glades of Gilead, on the "stormy banks" of the Jordan, which marks the close of the Exodus and the beginning of the conquest of Canaan.

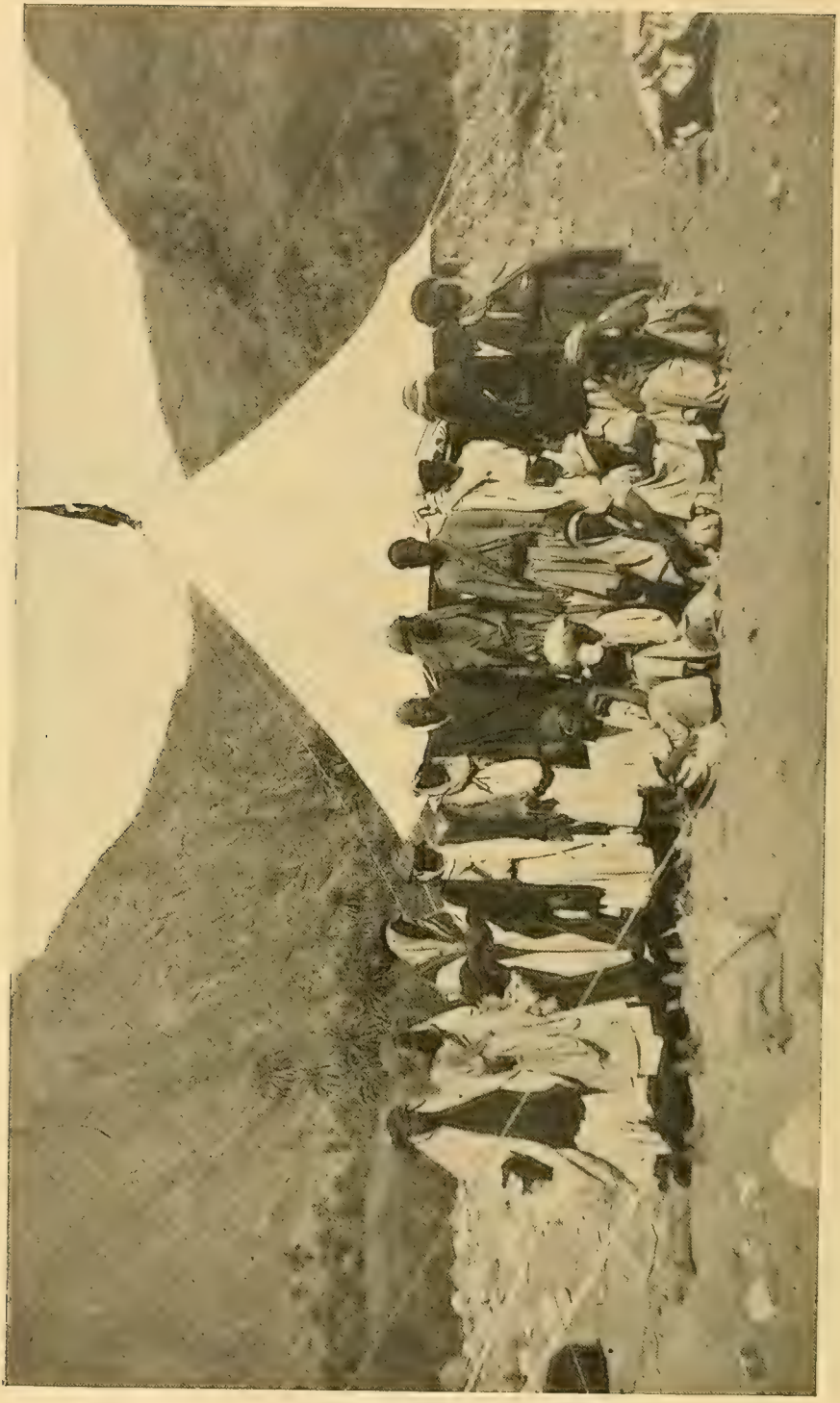
THE PROBLEM OF THE EXODUS

The problem of the Exodus, necessarily difficult in itself, has been complicated by a misreading of the Bible, by the confusion of mental processes and ideas which belong to other lands and centuries, by absolute misconceptions gained through art and song, and by the exaggeration of a number of subsidiary and minor problems which vanish with the first breath of the desert air. Many are apt to think of the Children of Israel as spending 40 years on the road to Canaan, but as a matter of fact "39 of these years were spent in camp and only one year was consumed in covering the entire journey of 1,100 miles between Raamses and the River Jordan."

Others are apt to think of the Exodus as having occurred in such a remote and vaguely indefinite past that we can never know anything accurate of its exact location in time.

While authorities have differed to the extent of 100 or even 200 years, yet it is certain that each fresh examination of the problem in the light of the most recent discoveries brings us closer to the actual dates. There are great difficulties

MAP SHOWING ROUTE OF THE EXODUS. FROM W. S. AUCHINCLOSS



OUR SINAI CAMELEERS: SHEIKH HAMMADI IS THE THIRD MAN FROM THE RIGHT, WEARING A WHITE TURBAN

in settling all dates for events the other side of the Christian era, but the data for Bible dates are superior to all other human records. Scholars have followed up ingenious clues, have made such good use of known astronomical facts and the unbroken sequence of Jewish feasts, that they venture to fix not only the year, but even the month and the day, when the Children of Israel left Raamses in the land of Egypt, and also the date of the crossing of the Jordan and their entrance into the Promised Land.*

Great confusion of thought has gathered round the words "miracle" and "supernatural." As a recent writer† has well said, "Everything we *admire* is literally a *miracle*," and among primitive people of all nations almost anything unusual was taken as "a sign and a wonder." "To most ages of mankind there has been no dividing line between the natural and non-natural; so much is inexplicable to the untrained mind that no trouble was taken to define whether an event would happen in the natural course or not." We modern thinkers have practically abolished the distinction between the "natural" and the "supernatural," but many fail to realize that we have done greater violence to the "natural" than to the "supernatural." We now distinguish sharply between the co-natural and the non-natural and make less use of the "supernatural" because of the confusion of mind occasioned by its mistaken uses.

THE APPEARANCE OF QUAIL, THE STOPPAGE OF THE JORDAN, AND THE WONDERS OF THE EXODUS CONFIRMED BY PRESENT CONDITIONS

"A strong east wind drives the Red Sea back; another wind blows up a flock of quails; cutting a rock brings a water supply to view, and the writers of these accounts record such matters as wondrous benefits of the timely action of natural causes." Modern believers in Divine Providence, and no one can accept either the blind-chance theory of the universe or that we are helpless automata, see incontestable evidence of God's care in the coincidence of these wonderful events with the desperate needs of the Children of Israel. With more light from many sources we shall modify our conceptions of many of these occurrences, but the facts will stand as long as the granite cliffs of Sinai.

The passage of the Suez arm of the Red Sea at the outset, the appearance of the quails, and the crossing of the Jordan forty years later are by no means the greatest difficulties and wonders of the Exodus. Those who have wandered over the sand dunes of the desert, have lost themselves among the shallow lagoons, and have watched the rise and fall of the tides among the inlets about Suez will have little difficulty in conceiving what may have happened in combination with "a strong east wind."

There is good authority for an entire stoppage of the flow of the Jordan by a landslide near Tell ed-Damieh during the 13th century, and those who saw people walk across the brink of Niagara Falls, when the river bed was almost dry by reason of an ice gorge above, will not tarry long on the passage of the Jordan.*

After we left Elim and were approaching the seacoast one of our cameleers suddenly rushed ahead of us some 25 yards and a moment later returned with a live quail in his hands which he had just caught. This event occurring at the very region where the Children of Israel were so abundantly fed by the flocks of quails, wearied by their flight over the Akaba arm of the Red Sea, was a wholly unexpected exemplification of the phenomenon of the Bible. It was the same east wind blowing over the same sheet of water into the maze of valleys that brought us our quail so weary as to be easily caught by the Bedawy of today. There is abundant confirmation from other sources that our experience was by no means unique.

The problem of the rainfall in the Sinaitic Peninsula, which does not seem

* Auchincloss, April 19, 1477, and March 21, 1437, B. C.

† Petrie, Researches in Sinai.

* A. D. 1267. See Palestine Exploration Fund Quarterly, July, 1895, pp. 253-261.

THE ONLY MEANS OF TRANSPORT IN ALL THE PENINSULA: THE SLOWEST IN THE WORLD

to have changed since 5000 B. C., has an all-important bearing upon the population before the days of the Exodus, and a no less important bearing upon the numbers of the Children of Israel who went out at that time. There are many separate lines of argument and research converging upon the commonly accepted figures which must reduce them to but a small portion of the 3,000,000 often spoken of.

THE ARMY OF 600,000 FIGHTING MEN IMPOSSIBLE

The climatic conditions being unaltered, the ancient population must have been about the same as that of today, 5,000 or 6,000 people. If the Children of Israel were about equally matched with their enemies at Rephidim, then there could not have been 600,000 fighting men. The land of Goshen, at the mouth of the Wady Tumilat, included an area of not more than 60 to 80 square miles, and could not have supported more than 20,000 people at the utmost. 600,000 fighting men would imply at least 3,000,000 people, which would equal if not exceed the whole population of the delta, and there is no trace of such a depopulation of this section of Egypt at the date required.

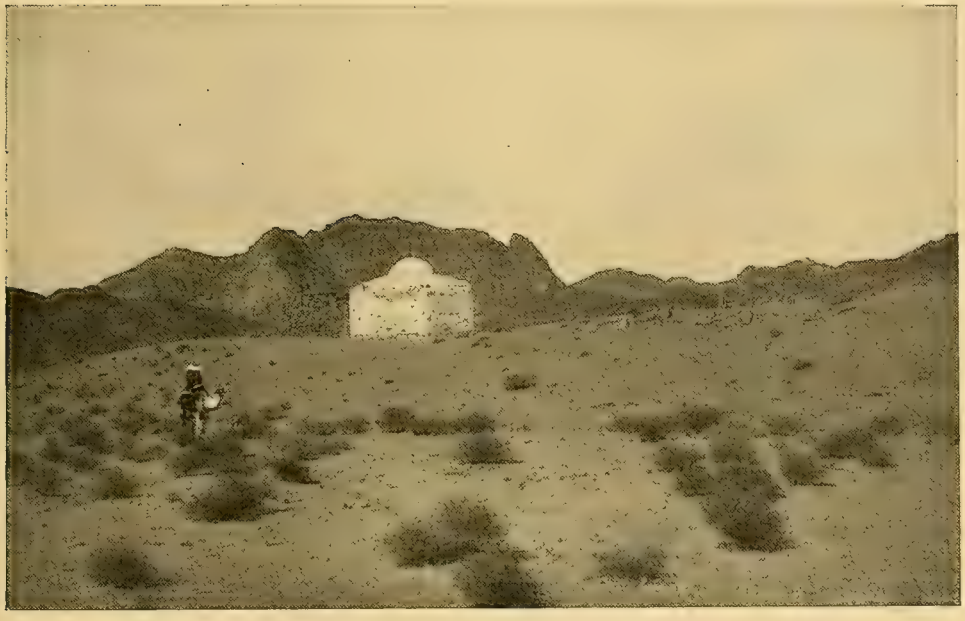
The crux of the figures, however, comes in the two census lists in Numbers I and XXVI. Those who are interested in the most modern solution of this difficulty will find the full statement in Petrie's Researches in Sinai, where the word "thousand" is taken to mean "group" or "family," and the results in figures reveal some startling mathematical facts.

While in Sinai we inquired carefully of the monks concerning the rainfall, and the head of the monastery, who has lived there since 1866, a period of 43 years, told us that not infrequently there were periods of three and four years in which no rain fell. The winter of 1907-08 was one of "much snow," but the total fall did not exceed 20 inches. Up to February 27, 1909, neither rain nor snow had fallen during the winter of 1908-09.

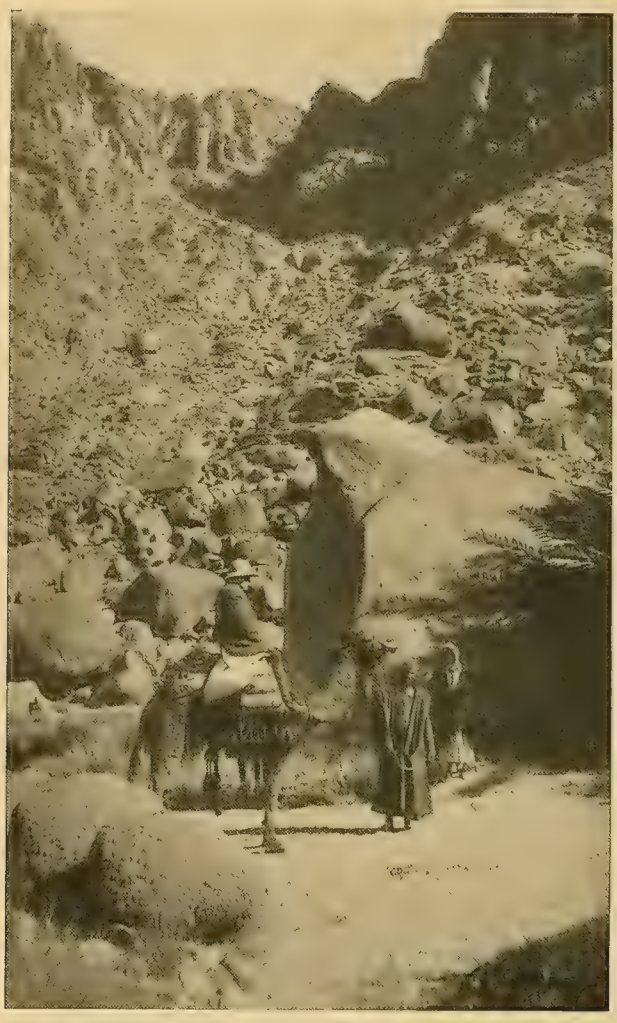
MOSES

The problem of the large numbers is intimately connected with the problem of the documents. Too much has been made of the composite nature of the Pentateuch and wholly erroneous conclusions drawn from fragmentary data. The best Egyptologists now accept Moses as a historical character, and his education in

SOME OF OUR CAMELEERS SETTLED DOWN FOR THE NIGHT: A LITTLE FIRE IN THE CENTER AND THEIR CAMEL FURNITURE BEHIND THEIR BACKS



THE TOMB OF NEBY SALIH, A FEW HOURS' RIDE FROM SINAI



NAGB EL HAWA: SOME NICE RED GRANITE BOULDERS NEARING SINAI

Egypt makes it certain that he and those about him were well accustomed to writing. They also accept the fact that the Israelites sojourned in Egypt, and that an exodus from there to Palestine took place.

The duplications and variations in the text of Genesis and Exodus (once the despair of the literalists) are now seen to be "the strongest proofs that written documents were before the editors of the Pentateuch, and that they were so ancient and revered that no unification was to be tolerated. This fact itself opens the door for a correction of the figures of the Exodus on exactly the same basis as other figures have been modified in the Old Testament text. Those who have examined the oldest manuscripts of the Bible, and have faced the known difficulties of transmission by copyists and translators through a few centuries, will have little difficulty in accepting emendations proposed and forced upon us by incontestable facts from other sources.

The impressions of the writer, after the most careful thought of the problem of the numbers, is this: To lead any number of people through the Peninsula of Sinai under the circumstances of the Exodus was one of the greatest undertakings of human history. To have led 3,000,000, with their flocks and cattle, was a physical impossibility, and would have involved an unbroken series of miracles far beyond the claims of the most ardent supporters of the "miraculous" in the series in which that word has been used and abused. But the writers of the Pentateuch make no such claims as this would certainly involve. The reduction of the numbers, for perfectly justifiable considerations, relieves the situation of its most perplexing elements and brings the whole movement well within historical limits without taking one iota from the divinely ordered plan.

Critics seated thousands of miles away in distance and three thousand years later in time have formulated doubts and queries, have raised imaginary difficulties which vanish into thin air when the observant traveler enters the almost changeless Peninsula of Sinai with the Bible in his hand. Some have gone so far as to

A CURIOUS BIT OF WIND CARVING IN THE DESERT OF SINAI

deny that the inspired writers had the Sinai region in mind at all. Nothing could be more gratuitous and farther from the truth. The Bible writers plainly knew that country as well as George Washington ever knew the country between Boston and Yorktown, and the writer, after 26 years in Bible lands and many journeys into these more remote portions, would record his conviction that the geography of the Bible fits the land as the key fits the lock, and each succeeding generation of men will realize this more clearly.

THE ROUTE OF THE EXODUS

The Bible record is complete as to the route of the Exodus, but many fail to realize this because the history of the journey is scattered through six of the Old Testament books, the record changing back and forth from one place to another nearly 100 times. Mr W. S. Auchincloss, C. E., in his little booklet "To Canaan in One Year" * has made a scholarly and valuable contribution to the problem of the Exodus in assembling and harmonizing all the Bible references and illustrating the route by an itinerary map. In order to bring out the names of the places with greater clearness he has omitted the mountain ranges and gorges, but "in plotting the line of march both their location and the gradients overcome have been carefully taken into account; hence the course shown is topographically correct." This map and accompanying letter-press was one of the most valuable books of reference that we carried with us into the wilderness.

In general it may be said that the first section of the route from Raamses to Sinai is known perfectly and the recovery of most of the ancient names simply a matter of time. The fourth and last section of the route from Elath, on the Gulf of Akaba, to Jericho is also well

* D. Van Nostrand Co., Murray street, New York.

NAGB EL HAWA: THE WINDY DEFILE LEADING INTO THE HEART OF THE SINAI GROUP, ALL OF RED GRANITE

known, and it is of enchanting interest to note that on this section all the most prominent towns mentioned in the books of Exodus and Numbers retain their ancient names till this present hour.* Maan, Dibon, Madeba, Heshbon, Amman, Edrei, Kenath, Salchad and Jericho are all found on our modern maps and are well-known towns to travelers in that region. It is perhaps not too much to say that on the first and last sections nine-tenths of the ancient names will be recovered clinging to the ruins and valleys and mountains of those regions.

The second section of the route, between Sinai and Ezion-geber, is now well known, but because it is an almost uninhabited desert the recovery of the ancient names has not progressed so far. But several of the more important locations have been fixed and we have pleasure in presenting on pages 1034–5 some unique views of Hazeroth and the country about Ezion-geber (Akaba).

* The Jordan Valley and Petra, Libbey & Hoskins. G. P. Putnam Sons, New York, vol. ii, p. 249.

The loop section of the route from Ezion-geber into the Wilderness of the Wandering and back to Elath is the least well-explored portion. It contains the well-known names of Kadesh Barnea and Mount Hor, where Aaron died and was buried. Thirty-eight years of the journey were spent about Kadesh, and it is here, if anywhere, that actual remains of the Exodus will some day be found. The site of Kadesh Barnea has been made the subject of dispute, but it is almost certain that the modern Ain Kadis, with its copious spring, several wells and pools, is really the ancient Kadesh. An equally vigorous dispute still continues concerning the identification of Mount Hor. Mr Auchincloss accepts the Jebel Madura, not far from Kadesh, but tradition as old as Josephus, accepted by Jerome and supported by the unanimous traditions of the Mohammedan and Jewish writers, identify Mount Hor with Jebel Neby Harun, about six miles south of Petra.* This Petra Mount Hor is by far the most imposing mountain (5,900 feet) and the view from its summit embraces more of

the Promised Land than Aaron could have seen from Jebel Madura.*

Out of about 80 place names on or near the route as plotted by Mr Auchincloss, at least 40 are known and identified with all certainty; ten more tentatively located; another ten have been conjectured, leaving only 15 or 20 of minor importance that are practically lost. Ancient names often itinerate with the changing currents of human life about a certain locality so that many of the names now uncertain will be picked up clinging to natural features or obscure ruins. A number of the camping places of the Children of Israel were named from events occurring within the camp and may have left no trace in the wilderness.

THE PENINSULA OF SINAI

The Peninsula of Sinai, within which lies the first two sections of the route, is that triangular region between the two arms of the northern end of the Red Sea. A line drawn from Suez to Akaba, a distance of 150 miles through the desert, forms the northern side of the triangle. The other two sides are bounded by the Gulf of Suez and the Gulf of Akaba. The Gulf of Suez, the longer arm, sweeping toward the southeast for a distance of about 200 miles, lies in the trough-like depression which separates Africa from Asia, and together with the Suez Canal forms one of the greatest waterways of the earth. The other arm, the Gulf of Akaba, extends north by west for 140 miles, being a continuation of the most remarkable rift upon our planet, that of the Dead Sea and the Jordan Valley.†

The area of this triangle, the Peninsula proper, is a little less than 10,000 square miles. It is one vast desert relieved by a few oases along the seacoast and deep among the network of rocky valleys. In the north and along both seacoasts are vast stretches of sand which forever shift before the winds from land and sea. Further inward are stony plateaus and great wastes of sand glistening with salt.

*The Jordan Valley and Petra, vol. II, p. 231.
† The Jordan Valley and Petra, vol. I, p. 86.

THE HUGE GRANITE RANGE OF SINAI IS ONE OF THE MOST IMPRESSIVE SIGHTS ON EARTH

But just south of the center of the Peninsula, like a great light-house between the continents, rises the huge granite range of Sinai to a height of over 8,500 feet. The triple peaks of Serbal (6,730 feet), Musa (7,363 feet), and Catharine (8,536 feet) all lie within a circle whose diameter is not more than 25 miles. Geologically this mass of primeval gneiss and granite, or "in more precise terminology, of colorless quartz, flesh-colored felspar, green horneblende, and black slate," is one of the most impressive sights of our earth. Since the days of creation these crystalline masses have undergone no geological changes, but have reared their summits above the ocean from the beginnings of time, unaffected by the transitions that have so completely changed the face of our planet elsewhere.

Only at their bases do these venerable mountains show any traces of alteration where the waves and the winds of the ages have crushed and ground their fadeless elements into the colored sands which filled the geological gulfs and bays of the Jordan rift and made possible the beauties of Petra and all that region.* Rising majestically from the encircling setting of desert and sea the whole mass is cleft and rifted and shattered into a fascinating tangle of sublime valleys, towering cliffs, awful precipices, and magnificent peaks which roll like billows far up into the crystalline blue of the heavens.

Long before the days of the Exodus this range was known as Horeb, or the Mountain of God, and into this maze of divine handiwork the Children of Israel were led only forty days or more after they had quitted the bondage of Egypt on the banks of the Nile. Here among these sublime valleys and majestic granite

*The Jordan Valley and Petra, vol. II, p. 251.

peaks they remained eleven months while Moses, under God's guidance, transformed the mass of Hebrew slaves into Israel the Chosen People, the miracle of human history.*

THE BEST MORAL AND RELIGIOUS SYSTEMS OF THE WORLD ARE LINKED WITH THE OLDEST GEOLOGICAL FORMATION OF OUR PLANET

Of course these mountain peaks and valleys have been encrusted with legends and shrines, but somewhere here within a little circle of 30 miles took place many of the most important transactions of human history in closest contact with God. The announcement of the Covenant, the manifestation of God's presence, the giving of the Ten Commandments, and the setting up of the Tabernacle are events that loom large in the history and the destiny of the race. Here among the indescribable beauties and grandeur of these granite mountains Moses laid the foundations of a civil code and instituted a complete form of religious worship.

It is no accident that the promulgation of the Divine Law, the fundamental principles of all the best moral and legal systems of the world, are linked with the oldest geological formation of our planet. There is a magnificent correspondence between the granite cliffs of Sinai and the unchangeable walls of moral truths.

THE INHABITANTS OF SINAI

The Peninsula of Sinai is a desert in which its dwindling inhabitants wander in search of food and water. All told the Bedouin do not number more than 600 souls. They are divided into four main tribes; are headed, not ruled over, by sheikhs who represent their followers before the government and who act as judges and referees in the never-ending disputes. These Bedouin dwell in miserable tents which are always pitched in lonely valleys and away from the routes of passers-by. When travelers enter the Peninsula the news is spread by means as mysterious as the wireless, and hungry fellows with their lean camels hasten from every tribe and wrangle for days and even weeks over the right and privilege to share in the transport of the traveler and his outfit.

Our group of 16 was led by Sheikh Hammadi. He was a wide-awake fellow and got about as much work out of such raw material as any one could have expected. Their habits of life, their never-ending and tireless powers of conversation, their dress, their food, their preparations for the night within the circle of their camel harness around a little fire was a fascinating subject of study.

The Peninsula must always have been thinly populated because so scantly supplied with water and means of subsistence. The present population would average only one person to every two square miles (compare Switzerland with 200 to the square mile, New Jersey with 250, and Oklahoma with 10), and they live largely on supplies from Egypt and the proceeds of escorting Greek pilgrims to Sinai. Politically they now belong to Egypt. They are tent dwellers even though they do build rude stone huts at certain of the oases where they gather for a month at the time of the date harvest. It is not too much to say that the only permanent habitations in all the Peninsula are the fortress-monastery at Sinai and its dependency at Tor, on the Red Sea, and these are occupied by Ionian Greek monks.

The route from Suez to Sinai is a nine days' journey on camels. Travelers usually make a short half day to the Wells of Moses, the first oasis four hours beyond Suez. Then follows a waterless tract of three days' journey to Elim, and no one ever making this trip will fail to realize what was meant by the oft-repeated request to Pharaoh that the Children of Israel be allowed to go a "three days' journey into the wilderness" with their wives and children and their cattle to sacrifice. Elim with its wells of water and its palm trees, unchanged to this present day and without human habitation, was the first possible stopping place after the edge of the desert had been crossed.

* Exodus, XIX-XL.

JEBEL SUFSAF, CLAIMED BY MOST SCHOLARS AS THE MOUNTAIN FROM WHICH THE LAW WAS PROCLAIMED TO THE PEOPLE IN THE PLAIN BELOW

This is the mountain that was enveloped in clouds and lightning reverberating with thunder while Moses tarried on its summit and the people waited below

TURQUOISE MINES WORKED 4,500 YEARS AGO

Two days beyond Elim we visited the famous turquoise mines of Meghara, where the Egyptians mined as early as the Fourth Dynasty (2500 B. C.), more than 4,500 years ago, and left a curious collection of rock carvings and tablets which have been of priceless value in their bearing upon Egyptian chronology. It was a wild desert valley in which the poor convicts worked under the lash. The mines at various elevations above the floor of the valley were dug into the mineral-bearing strata sometimes for hundreds of feet. At least two unsuccessful efforts have been made in modern times by foreigners to reopen these mines and some of the Bedouin are still at work digging and searching in a primitive way for the bits of green malachite which they offer for sale in Suez and Cairo.

Two days beyond the mines carried us to the oasis of Firan, rightly designated "The Pearl of Sinai," the most fertile tract and one of the most interesting spots in the whole Peninsula. This will be treated of in a special article at a later date and illustrated with a unique series of photographs.

THE MONASTERY OF ST. CATHERINE

Our camp in the Oasis of Firan was at an elevation of about 2,100 feet, and in the following two days we crossed the watershed beyond Wady Sahab, at an elevation of 3,900 feet, and made a slight descent before our last climb over Nagb el-Hawa (4,900 feet) to the Plain of er-Rahah, which most scholars have regarded as the camping place of the Israelites while waiting for the giving of the Law. The two panoramic views from the upper end and the center of the plain with Jebel Sufsaf, the nearer peak of Jebel Musa or the Mountain of the Law, towering in the center of the picture, are among the most sublime mountain prospects in the world. This is the mountain that was enveloped in clouds and lightning reverberating with thunder, a mountain that could be touched, while Moses tarried on its summit and the peo-

JEBEL SUFSAF: THE MOUNTAIN OF THE LAW

As seen from the Plain of er-Rahah, where the Children of Israel awaited the giving of the Law. The mountain masses on all sides are of red granite, forming one of the most sublime views of the world. The Valley of the Convent of Saint Catharine is exactly in the center of the picture.

CONVENT OF SAINT CATHARINE AT SINAI, WITH THE GARDENS AND MORTUARY CHAPEL TO THE RIGHT

ple waited below. And just to the left of this peak, Jebel Sufsaf, is the valley of the Deir, in which stands the monastery of St. Catharine, the goal of our long journey and one of the most fascinating places in human history.

About the middle of the fourth century when the Byzantine Christians began the exploitation of the holy places the Peninsula of Sinai was peopled by anchorites and coenobites who were bound by a common monastic rule. Traces of their occupation are found in all the mountain valleys dating from the massacres which attended the Saracen invasion. The only spot in the Peninsula which was not submerged in the advancing tide of Islam is the monastery of St. Catharine, which thus becomes an interesting relic of those early Christian centuries.

This picturesque monastery standing in a sublime valley of the Sinai group occupies the site of a fort built by the Emperor Justinian in 527 A. D. It is a hoary pile of old buildings, entirely enclosed by a high wall, on one side of which toward the mountain a few old rusty cannon still do sentinel duty. A lower wall encloses the adjoining delightful gardens which have been wrung by incessant toil from the rocky mountain side below. The fortress-monastery has witnessed many a thrilling event in history, has withstood many an attack and siege, and bears the marks inside and out of its stormy history.

The present entrance for all purposes, after the traveler has been admitted to an outer courtyard, is a low door with two sharp turns within the passageway and capable of being barricaded successfully against the most determined invader. At the first sign of danger this door is still closed and partially walled up, and then the only means of entrance and exit is the windlass, 2½-inch rope, and the basket which is let down from a portcullis on the high wall towards the north. This primitive elevator is in good working order and is a grim reminder of the strenuous conditions of life through all the passing centuries.

ITS FAMOUS LIBRARY

The monastery is now a pilgrim shrine of the Greek orthodox church and under the protection of Russia is safe from molestation. Out of its now famous library came the *Codex Sinaiticus,* easily the most precious of all the Bible manuscripts in existence. It was discovered by Tischendorf, a German scholar in 1844, and dates from the fourth century. Alexander II, of Russia, succeeded in purchasing this priceless manuscript and it was carried to St. Petersburg in 1869.

The kindly monks, now about 30 in number, are all Ionian Greeks and live under a very severe monastic rule. The accommodations of the monastery are sorely taxed by the bands of Russian pilgrims, sometimes 100 in number, which come from Suez once or twice a year.

The main church is an early Christian basilica containing a wealth of detail and symbolism of intense interest to the archæologist. The oldest part of the structure is undoubtedly "The Chapel of the Burning Bush," said to mark the spot where God appeared to Moses. All visitors are obliged to remove their shoes before entering. The dim light scarcely reveals the wealth of porcelain, chased silver, fresco, and handsomely wrought lamps.

A ray of the sun is said to enter this sanctuary once a year only, gaining admission through a cleft in the mountain ridge on the opposite side of the valley. With a fine sentimentality the monks have erected a large cross on the mountain ridge, so that the shadow of the cross must touch this site of the Burning Bush once a year, and the ridge is called The Mountain of the Cross.

Behind the church is the well from which Moses is said to have watered the flocks of Jethro, and where he met his future wife.

THE MOUNTAIN OF THE LAW

But the great shrine is the ascent of Jebel Musa, the Mountain of the Law, which rises 2,350 feet above and behind

THE PLAIN OF ER-RAHAH, SEEN FROM THE MOUNTAIN ABOVE, WHERE THE CHILDREN OF ISRAEL WAITED FOR THE PROMULGATION OF THE LAW

the monastery. The pilgrimage steps, said to be 3,000 in number, are broken at many points, but still form an impressive ascent to the noble mountain top. There is a shrine to the Virgin Mary and a chapel to the Prophet Elijah on the way up. At one narrow passage still exists a gateway where pilgrims formerly made final confession before being allowed to tread the way to the summit sacred to Moses, and made forever holy by the giving of the law.

The view from the top is wild and imposing beyond the power of any pencil or camera. The other peaks of this Sinai group cut the heavens in every direction, a tangle of smaller mountains and valleys lie almost at one's feet, while far beyond in clear weather a bit of the Red Sea and the greater part of the Gulf of Akaba are visible. On the way down a detour can be made to the traditional cleft connected with the giving of the law, through which we get a splendid view of the Plain of er-Rahah, where all the Children of Israel could have stood within full view of the peak Ras Sufsaf and have heard, from its lower slopes, the human voice of the Law-giver cutting through that wondrous desert air.

Beyond Sinai the route of the Exodus, within the Peninsula, is fixed beyond a peradventure by the configuration of the valleys, the one or two well-known locations and the water supply. We left the monastery by the Wady esh-Sheikh which we followed as far as the tomb of Neby Salih, accounted by the Bedouin as one of the most sacred spots in the Peninsula. Palmer attempts to identify this Bedouin saint with Moses himself, and there are many considerations which bring this within the realm of possibility.

Turning out of Wady esh-Sheikh through a side valley we soon reached a divide beyond which the country changed instantly.

A wide plateau showed signs of vegetation, where grazed hundreds of camels and thousands of sheep, lambs, and she asses. The whole skyline took on a softer, smoother look, and the sides and bases of the mountains lost the sharp, forbidding aspect of Sinai. We had passed suddenly from the granite into the limestone formation, and a day later we had dropped from 5,100 feet, at Sinai, through the Wady Saal, to 2,600 feet, at Wady Shukaa, and pitched our tents among the beautifully colored sandstone cliffs. From its elevation it is plain that these sandstone strata on the west side of the continuation of the Arabah are of the same age and origin as those which form the glory of Petra.* Here we made one of our most fascinating desert camps beside a huge mass of crumbling sandstone, and realized what "the shadow of a rock in a weary land" must mean in the scorching heat of summer.

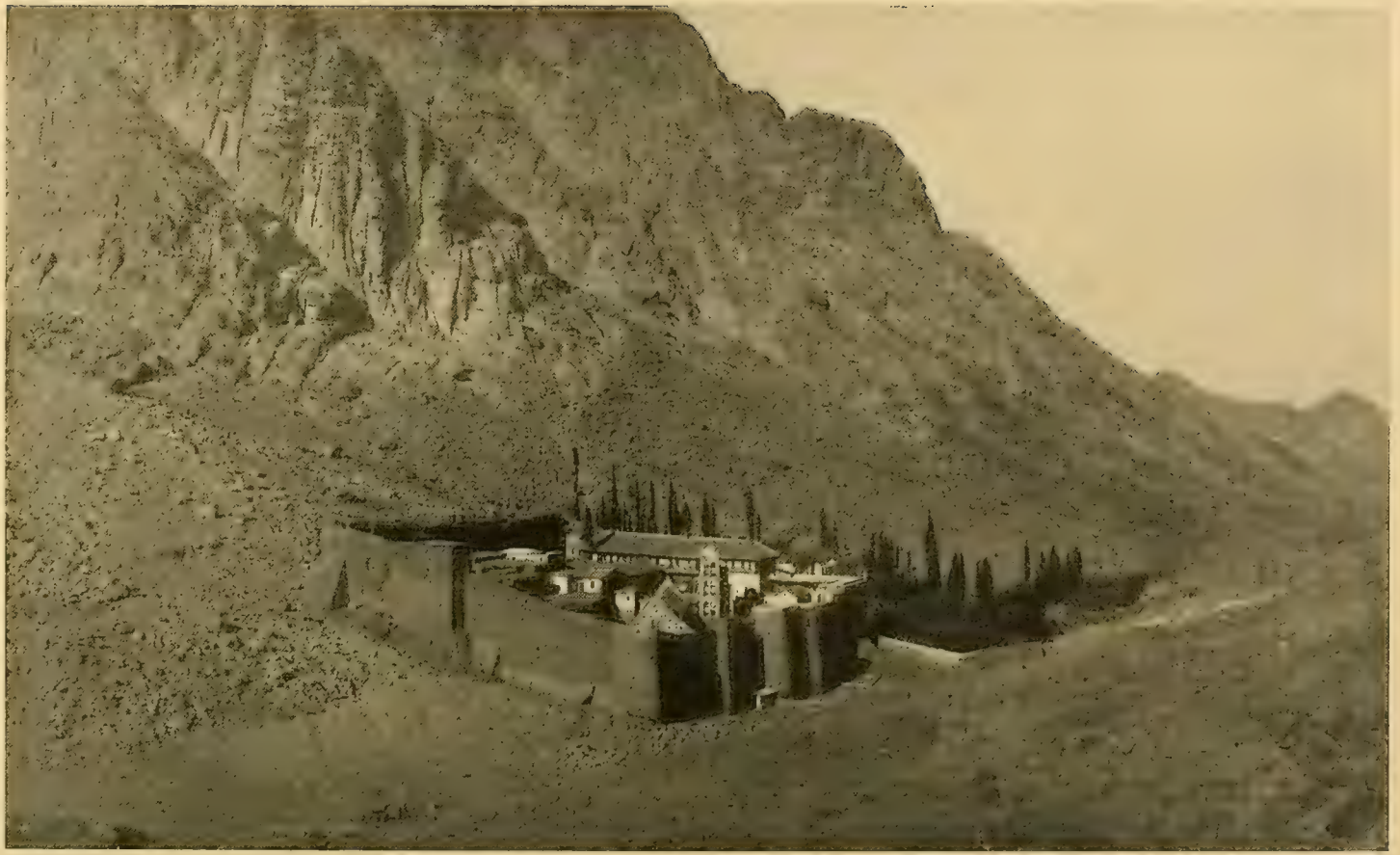
HAZEROTH, WHERE MIRIAM, SISTER OF MOSES, WAS STRICKEN WITH LEPROSY

Three hours beyond this camp we had one of the most thrilling experiences of our journey. After a tiresome stretch over sandy plains and winding among weird sandstone cliffs and crags, we rode up a long slope towards a break in the limestone hills and suddenly looked down into one of the most beautiful and romantic nooks of the Peninsula.

It was the oasis of Ain Hudherah, the Hazeroth of the Exodus (Num. 11:35-12:16) where Miriam and Aaron spoke against Moses because he had married a Cushite woman. Here Miriam was stricken with leprosy and "shut up without the camp for seven days and the Children of Israel journeyed not till Miriam was brought in again." The panorama on page 1034 is taken from the top of the gorge about half a mile away from the little oasis and at least 300 feet above. It took us fully half an hour winding back and forth among the deep sandstone ravines before we emerged on the yellow and white sands and entered the oasis through a beautiful natural gateway.

The other panorama on page 1035 gives some idea of the plaza-like cavity among the rocks, with the cliff rising several hundred feet on three sides of the parallelogram, which was 300 feet along one end, 1,000 feet along the side, and 400

*The Jordan Valley and Petra, vol. ii, p. 117.



THE MONASTERY OF SAINT CATHARINE AT SINAI, IN THE VALLEY OF THE DEIR, DATING BACK TO 527 A. D.

Jebel Musa, the Mountain of the Law, is the great granite mass to the left and the stairway of 3,000 steps to the summit climbs one of the ravines at the extreme left of the picture

THE ONLY ENTRANCE TO THE MONASTERY OF SAINT CATHARINE, SINAI
The door is five feet high

feet along the other end. It also shows the double group of palm trees, perhaps, which get their life from the fountain which eternally fights its way up through the drifting white sands. The main stream of the fountain comes from a small tunnel, at the inner end of which is a cleft in the apparently solid rock.

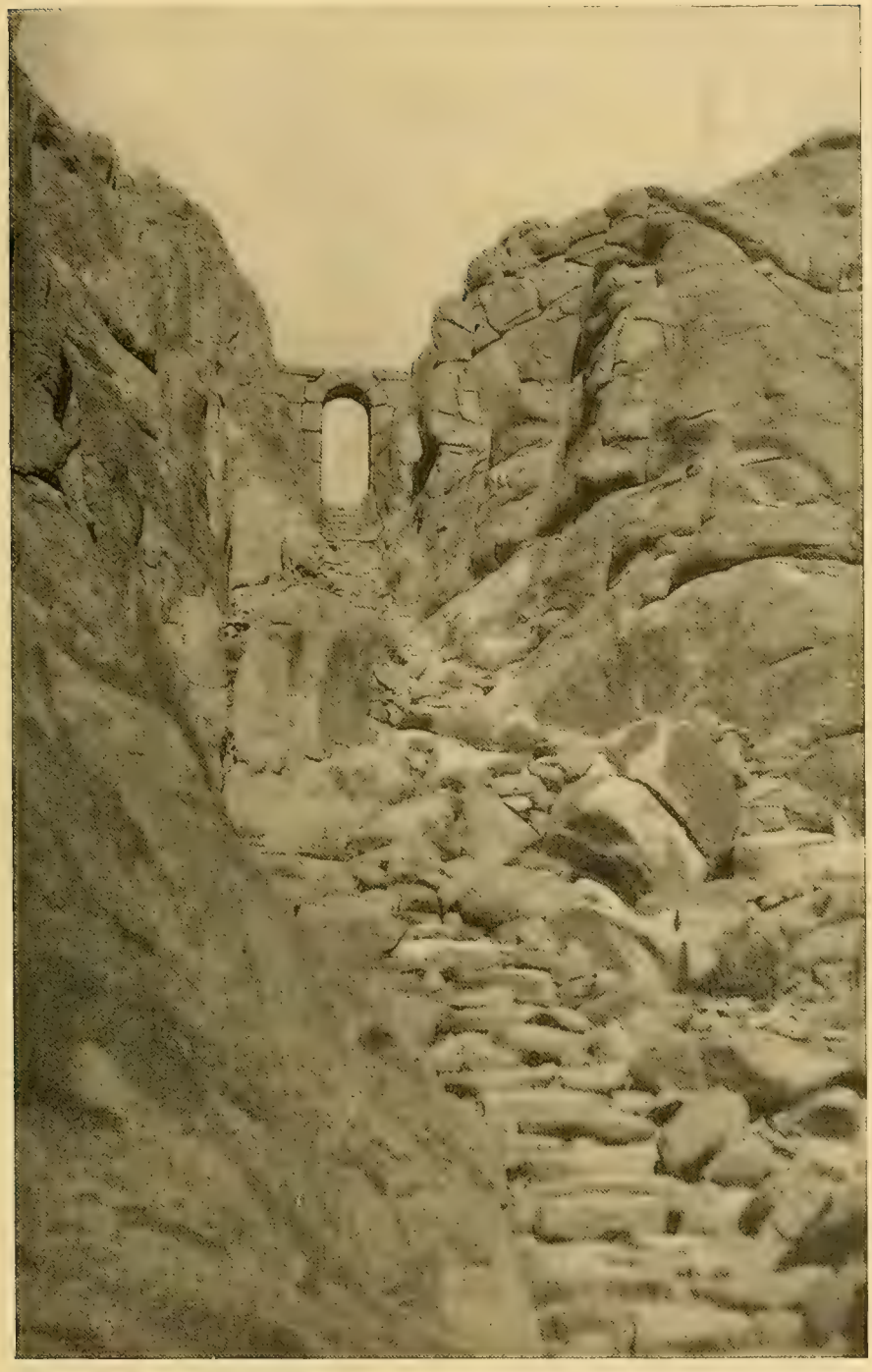
Outside the cutting for some 30 feet, is a deep, open cutting for some 30 feet, and then begins the gardens where a deaf and dumb Bedouin watched the few spots sown with wheat, turning the stream from place to place until it was lost in the drifts of pure white sand. Because of the two groups of palms it would almost seem that there was a double fountain, or some sort of a tunnel which carried the precious water across the strip of sand that lies between the two groups.

The weary traveler coming upon this delightful nook from any point of the compass will never forget the sight of this wonderful little oasis. At least four possible roads converge here. The one we followed from Sinai and the one we took northward to Akaba, and two others up into the desert plateau above, one of which leads straight to Suez and the other to Gaza on the borders of Palestine.

Between Hazeroth and Ezion-geber lie the still unsolved portions of the problem and route of the Exodus. After reaching the shore of the Red Sea, they turned northward, and for 38 years roamed about the neighborhood of Kadesh. Into this Wilderness of the Wandering, explorers are now penetrating from the north, the west, and the south, and a few years hence we shall have as good maps and details of it as we have of the other sections of the route.

Our plan carried us down from Haze-

THE MONASTERY OF SAINT CATHARINE, SINAI, SEEN FROM A POINT ON THE STAIRWAY LEADING UP TO THE MOUNTAIN OF THE LAW



GATEWAY ON THE STAIRWAY TO THE TOP OF THE MOUNTAIN OF THE LAW

THE ROCKY ROAD WINDING DOWN INTO HAZEROTH

ENTRANCE TO THE OASIS OF HAZEROTH

A BEAUTIFUL FOUNTAIN IN EDOM, WITH BEDOUIN WOMEN FILLING WATER SKINS

roth through a series of sublime valleys to the shore of the Gulf of Akaba, at Nuweiba, where we met another surprise in the shape of an Egyptian fort built about 16 years ago, when the boundary question between Egypt and Turkey was causing friction. It stands in an oasis of palm trees which fringe the shore of a beautiful little bay. The building is about 200 feet square and a well of good, but brackish water in the courtyard. Five years ago it contained some 200 soldiers of the Egyptian army, but after the settlement of the boundary in 1906, it was left in the charge of two forlorn guards, who hoist the Egyptian flag daily and waylay passers-by for tobacco and with messages to their families in Akaba.

Two days' ride along the shell-strewn shore carried us to the boundaries of Egypt as fixed in 1906, after the sharp encounter between Great Britain and Turkey, when Great Britain put her fleets in motion and notified Turkey that if the Turkish troops then within the disputed territory were not removed at a certain date there would be war. After the withdrawal by Turkey a commission fixed the boundary by erecting a line of stone and steel pillars from below Akaba on the gulf across the desert to the Mediterranean Sea at el-Arish. The first of these pillars stands on a high bluff, 100 feet above the sea, beyond the little fortress-crowned Island of Pharaoh, and is visible for many miles overland and far out at sea. It is a mute but impressive token of the power which, from its island home, controls so much of the blue waves and the winding shores of the habitable earth. Beyond this line of pillars we entered the Turkish Empire and an hour later struck the Egyptian caravan route which takes the straight course across the Peninsula from Suez to the Abaka arm of the Red Sea.

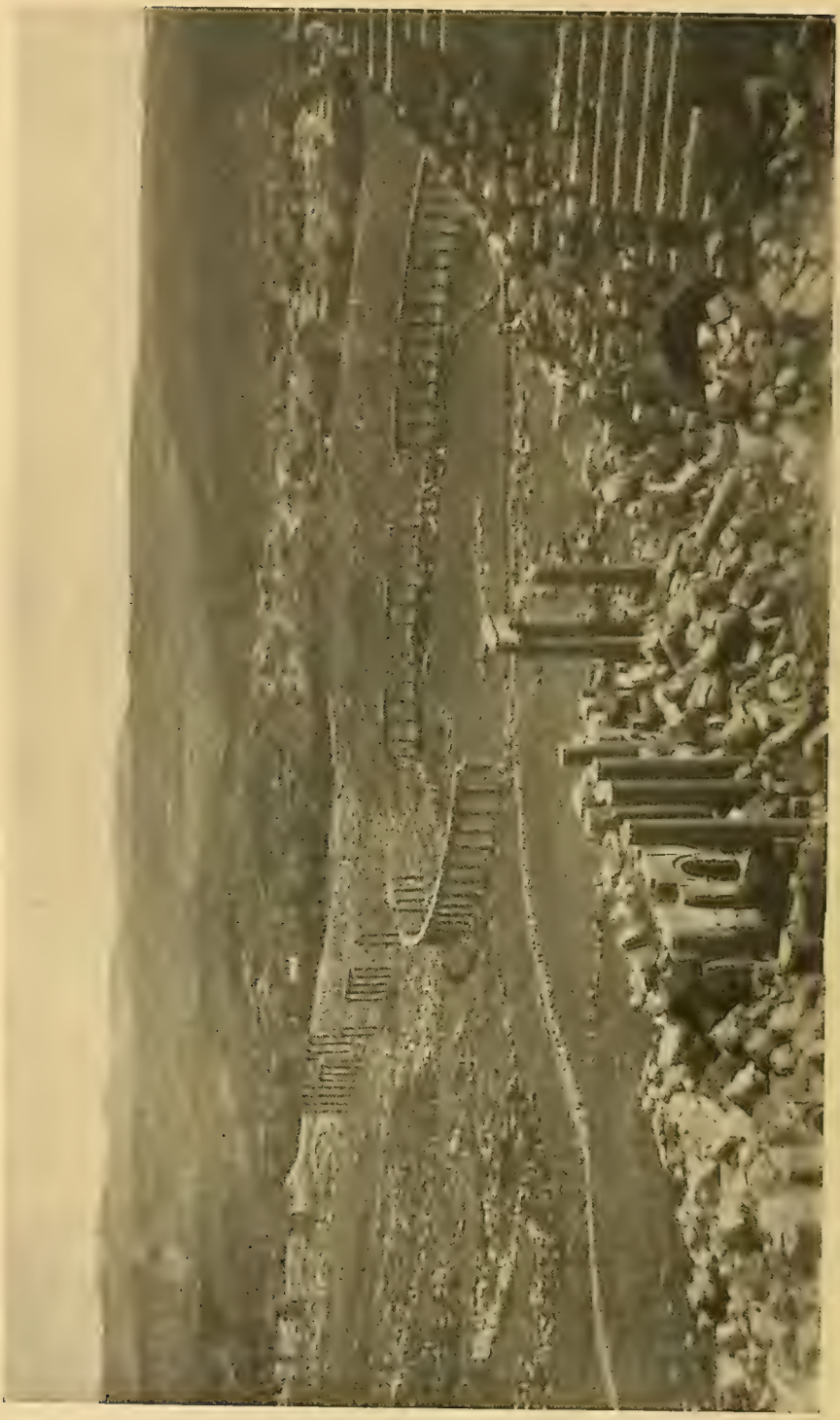
EGYPT IS LEFT BEHIND

For two days and more we had been looking over the water from Africa into Asia, and now we were approaching another turning point in our pilgrimage. Nothing could have been more beautiful than the sunlight playing over those quiet waters and upon the barren mountains beyond, into which as yet no Christian travelers have ever been allowed to go except by stealth. We swung round the

OASIS OF HAZEROTH, SEEN FROM THE PASS ABOVE AND ABOUT A MILE AWAY

The oasis is the black spot exactly in the center of the picture

HAZEROTH, A BEAUTIFUL OASIS WHERE THE CHILDREN OF ISRAEL TARRIED SEVEN DAYS, WHEN MARIAM, THE SISTER OF MOSES, WAS SMITTEN WITH LEPROSY



JERASH: A CITY OF THE DECAPOLIS, ON THE HEADWATERS OF THE JABBOK

A NARROW BIT ALONG THE SEASHORE OF THE GULF OF AKABA

SOME CALLERS AT OUR CAMP IN THE LAND OF EDOM

head of the Gulf and across the utmost extremity of the Jordan Valley rift and entered the town of Akaba. It is a beautiful spot—seen from a distance—because of its oasis-like clusters of palm trees and the shimmering seat at their base.

But the town itself inside is wretchedness and filth personified. Rain seldom falls here and the dirty inhabitants drink from brackish and almost putrid wells. The old castle or caravansary is half in ruins and the other houses are moldering mud heaps. If one heavy rain ever came these houses would crumble into complete ruin in a few hours. The people are despicably poor in their persons and characteristics, having lived like leeches on the Egyptian caravans to Mecca for centuries.

For us, however, the town was a memorable camping place. It marked the successful close of our journey across the Peninsula. The commander of the Turkish troops handed us telegrams that brought us into contact with the modern world again. Only fifteen minutes before our caravan of 22 slowly moving camels came around the seashore and into the shadow of the palm trees another caravan of 18 horses and mules, led by two fine soldiers from Beersheba and riding swift camels, dropped their burdens at the same spot. They had made a journey of 19 days down from Beirut, via Sidon, Tyre and Jaffa, to Beersheba, and then across the wilderness to meet us at Akaba. They brought us a fresh supply of provisions and charcoal, and two boxes of oranges from the groves at Jaffa and, best of all, letters from home. There was great joy in the camp that night.

The next day we dismissed the cameleers and started them back to their desert tents about Sinai, while we took up the more familiar journey over the fourth section of the route of the Exodus. A guard of twelve horsemen, seven foot-soldiers, and our two soldier cameleers from Beersheba, accompanied us over the rough and almost waterless valleys to Maan and Petra. We pitched our tents in Edom, Moab, and the Land of Gilead, at the Arnon, at the Jabbok, and then at the Jordan. Our last climb was up the slopes of Judea, and when we entered the earthly Jerusalem, the city of David, the city of its Greater King, it seemed as though we had lived through all ancient history, so freighted were our memories with the events and scenes of the desert and the Exodus.

PHARAOH'S ISLAND AND RUINED CASTLE

ARABIA, THE DESERT OF THE SEA

By Archibald Forder, of Jerusalem

With Photographs by the Author

THE great peninsula known in these days as Arabia is one of the oldest known parts of the earth. Long before the sons of Jacob went down into Egypt, the sons of Ishmael had settled in the land Providence had assigned them. The boundaries of Arabia are outlined as early in the Bible as Genesis xxv. 18. Probably many centuries ago Palestine, Syria, and the Sinaitic Peninsula were important parts of Arabia. Isaiah speaks of it as the "desert of the sea" (xxi. 1), and when one considers it a land largely desert, almost entirely surrounded by water, we conclude that the ancient seer was not far wrong in his designation of the land. Arabia is between Egypt and Persia, to put it widely, also between India and Europe. It has a seacoast of about four thousand miles.

No land so little attracts the attention of the speculator, hunter, adventurer, or traveler as Arabia, and yet no country presents so large or new a field as the subject of these lines.

Many are the obstacles to be faced and overcome ere one can see and learn for oneself what is beyond the mysterious and almost waterless belt of uninviting desert that encircles this little known land, but a few have penetrated the country from different points and each has shed some light on the interior.

The first and perhaps the most difficult obstacle to contend with is the rigid persistence of the Turk, who practically controls the entire coastline of Arabia, but who holds little sway inland. Those landing on the coast with the intention of proceeding to the interior are met by smiling officials, who politely request your permission from Constantinople to proceed inland, and, on failing to produce that, you are recommended to procure the same by telegraphing to your representative in the metropolis of the empire—a costly and usually hopeless procedure.

If, however, an entrance is gained, as has been done, troubles of other kinds have to be overcome, such as the difficulties of transportation, the superstition of the natives and their dislike of the Christian, the latter perhaps the most dangerous if not the most formidable.

Arabia is probably one of the oldest of Oriental countries and at different times has played important rôles in the making of the world's history, and the probability is that in the revival of the Orient it will yet figure prominently once more.

As a whole, the country is about as large as the United States east of the Mississippi River, and has an area of some million square miles.

The northwest part of Arabia is famous for its many-hued mountains, rocks, and crags, into and out of which has been hewn many a fine tomb, temple, dwelling, and theater by the Nabathean, Roman, Greek, or Egyptian, all of whom have left their mark behind them.

Petra, as it is called today, is comparatively easy of access, either by rail from Maan, on the Mecca Railway, or on horseback from Jerusalem via Moab and Edom. For their own protection the Turkish authorities insist on the traveler having a military escort, which is furnished at a nominal sum. This insures freedom from annoyance from the lawless and wild Bedouin that are located in that section. This interesting portion of Arabia has been previously described in this Magazine,* so it is not necessary to again cover the ground.

Steering east from Petra one can soon

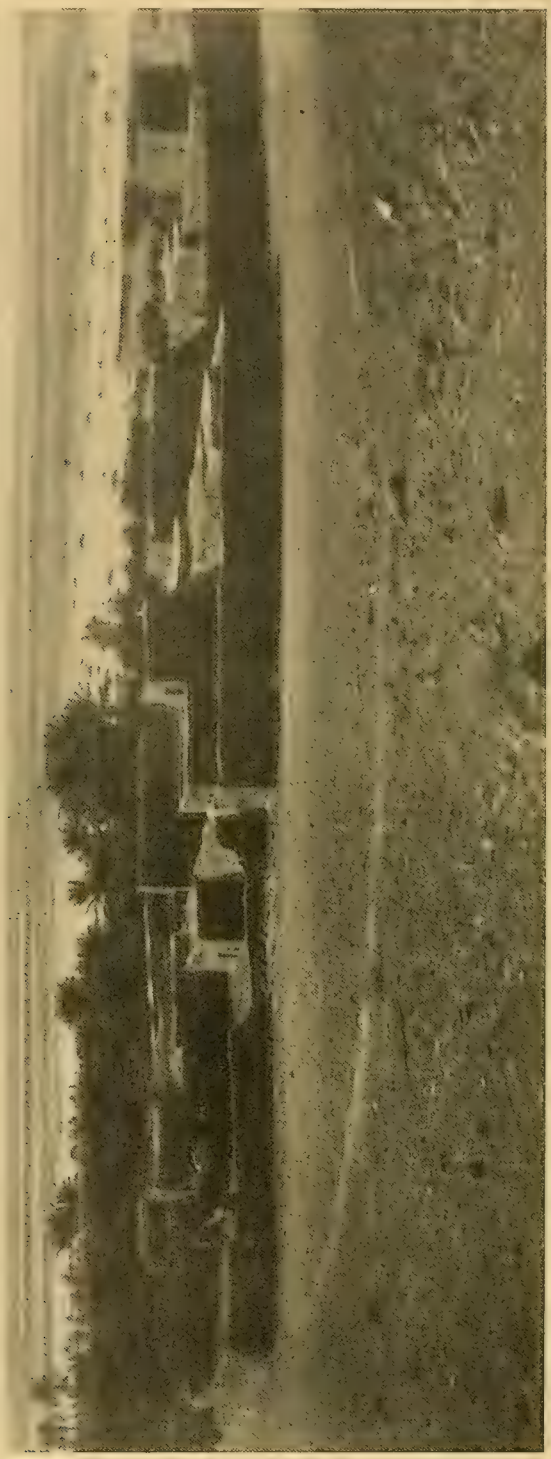
* Rock City of Petra. Franklin E. Hoskins. Nat. Geog. Mag., May, 1907.

THE ROCKY DEFILE, OR THE SIK, WHICH WAS THE ENTRANCE TO PETRA

This wonderful rock-hewn city is located in North Arabia. Access to it is through a gorge about a mile long which was once paved and spanned by several arches. The illustration shows the western outlet of this fascinating ravine.

PHARAOH'S TREASURY: PETRA

This magnificent piece of work, cut like a cameo out of the rock, is an example of the temples and tombs to be found in North Arabia. The excavation is about 87 feet high and 40 feet wide, and has three inner chambers of large dimensions.



THE OASIS OF KAF

Situated in the midst of the North Arabian desert, and governed by the Arabian Prince Ibn-Rasheed. Few Europeans ever reach this out-of-the-way place

COLLECTING SALT OFF THE DESERT

Large quantities of salt are exchanged for the daily necessities of life in Arabia. It is obtained from brine springs that are numerous in Arabia.

be lost in the trackless expanse of Arabia Deserta, and here really begins the new field of research and travel.

Due east of Medaba, on the plains of Moab, near Nebo, and at some 200 miles distant, is the twin town of Kaf, surrounded entirely by the desert. This place is under the jurisdiction of the great Ibn Rasheed, the independent ruler of Arabia, and is controlled by a local chief who is responsible to his lord and master in the distant metropolis of Hayil. To him the chief has to remit an annual tax of 80 cents for every male in his district, and to him must be referred all cases too difficult for solution by the local representative.

The Kafites obtain the necessities of life by the accumulation of salt, which is bartered in large quantities to men who come with caravans from the north, having with them wheat and barley to exchange. All around Kaf are never-failing springs of brine, which is drawn in skins and poured into shallow beds in the sand. The extreme heat soon evaporates the water, leaving a solid deposit of white crystal salt. When thoroughly dry this is stored in mud bins to await the coming of buyers.

This commodity, so essential to the daily life of the Arabian, generally fetches measure for measure of wheat and twice as much in barley, the former being preferred. The cultivation of the date-palm also claims a portion of the Kafee's time, not so much, however, for profit as to provide the morning meal

MEASURING SALT

Caravans carry salt from the oases to all parts of Arabia. It is usually bartered for wheat or barley. When dry it is stored in the open air in huge mud bins like the one shown in this picture.

CAMEL AND YOUNG

Thousands like these graze on the plains and deserts of Arabia. The female is rarely used for riding, not being accustomed to the strain

for himself and family. If he be an unusually energetic or ambitious man (which is unusual), he may cultivate dates to sell, there always being a demand by those who come with the caravans.

East of Kaf, about 25 or 30 miles, is a smaller oasis named Ithera. The people are less intelligent and most unkindly disposed to all outsiders, as the writer has good cause to remember, for it was here he had his first real experience of Arabian superstition and hatred of the Christian.

It came about thus: I had come unceremoniously among the people of Ithera without the necessary and all-important introduction to the chief. This for me was unfortunate, as it placed me in the position of not being under any one's protection, an important thing in such an out-of-the-way part of the world and among such an unfriendly people.

My sudden appearance in the guest-room of Ithera, without any previous idea of my being in the town, gave cause for speculation as to who and what I was. One suggested a Jew, another a Christian, another one of the heathen, another an infidel, while the last, more daring than all, informed the assembled wonderers that I was neither of what they had suggested, but a pig. I at length put them right on the matter by informing them that I was a Christian, upon which I was ordered by the chief to take my place with the cattle in the stable part of the guest-room.

This I did, but was not allowed long thus to remain, for the suggestion was volunteered that my near presence to both camel and horse might result in the speedy decease of both. So I was given a place to myself under the shade of a beautiful palm grove; but here my stay was shortened by the remark that "probably my close contact with the palms would hinder them from again bearing fruit." So again I was requested to move, this time being confined in a tent to keep company with one afflicted with a disease not unlike leprosy.

Thus was my first contact with the

isolated dwellers of the "desert of the sea." Alas for ignorance and superstition! How true the saying of the Bedouin: "He who travels not is both blind and ignorant."

The small population of Ithera, much less than Kaf, eke out an existence in much the same way as their neighbors, by evaporating salt from the springs that surround their tiny oasis, and it is only because their needs are so limited that they are able to exist.

Adjoining Ithera on the south is a prominent tell or mound about 100 feet high; on its top are the remains of an old castle which at one time must have been quite a stronghold and landmark in the desert.

Ten days' journey, as laden camels travel, south from Ithera is the great oasis of El Jowf, probably the largest center of population in northern Arabia. The word Jowf in Arabic means depression and literally verifies what it expresses, for El Jowf is indeed a considerable drop in the great expanse of Arabia.

I was fortunate in being able to journey from Ithera to El Jowf in company with the sheikh, *i. e.*, chief of Ithera, an opportunity that for me was fortunate, as it afforded me some amount of protection as well as secured for me a reliable and trustworthy escort across the desert. The company with which I traveled was composed of about 80 men and 120 camels, the latter laden with wheat that was to be bartered for dates or some other produce of El Jowf.

Great were the objections made to my accompanying the party across the desert, for would not I, being a Christian, bring trouble on the caravan? So argued the more fanatical of my traveling companions, and it seemed to them with reason, for a few hours after starting our party was set upon by a robber band, and in spite of our coming off victorious the blame for the attack was laid upon me.

Some insisted that I be sent back, others that I be left to shift for myself, but my friend the sheikh said, "No; to the Jowf the Christian goes, even though we travel alone," so the next ten days were passed riding over the sandy expanse between Ithera and El Jowf in company with men strongly opposed to the presence of the Christian in their midst.

To me words fail when any description of the desert has to be written or given. It has to be lived in, crossed, slept on, made one's place of abode for a time in order to be really and thoroughly enjoyed. The boasting of the Bedouin about the free life they enjoy, and their pity for their city neighbors, confined in their close and dark dwellings, can be excused after a sojourn in the desert itself. But the desert life is not all honey by any means, for is there not always the danger of attack from the nothing-to-lose and all-to-gain Bedouin, or the risk of perishing for want of water, or the giving out of one's food without the possibility of being able to replace it? True, all these have to be reckoned with by him who would explore "the desert of the sea," but dangers of all kinds abound in every land and are not confined to Arabia.

The daily routine of travel was much the same. Up with the daybreak and as soon as possible load the camels; ride for some four or five hours; then put down for our first and morning meal, which usually consisted of dates and water; then off again until late in the afternoon, when a halt is made for the night. Supper usually consists of warm bread with an onion or dates as a relish.

Bread is prepared in as simple a manner as possible. While the coarse flour and water are being kneaded into dough a large fire is made which provides a good heap of hot ashes. On part of these the flattened dough is laid, then covered with the remainder of the ashes. In about fifteen minutes the dough is sufficiently baked. It is then well beaten to free it from ashes, broken in pieces, and divided among those who from their bags have contributed to the meal.

After the evening feast coffee is made by some member of the party and in tiny cups handed round to each one, as much

DATE-PALM WITH RIPE FRUIT

Dates take the place of bread in Arabia. There are many varieties. The date harvest comes in December and January and is a busy time for the natives

ITHERA, A HAMLET IN ARABIA

Probably once an important place guarded by a castle located on the high hill seen in the illustration. It is now a stopping place for caravans going into and from Arabia

THE CASTLE OF MARID

This formidable structure, now in ruins, stands at the north end of El Jowf, in North Arabia. The Arabs think it contains treasure buried there by the ancients. It serves no purpose at the present time.

regard being paid to etiquette as if they were assembled in the most spacious guest-room in the largest city in the country.

Conversation never lags, and until late in the evening the men talk, some telling imaginary stories, others reciting impromptu poetry, until, tired out, all except those designated to keep watch roll up in their large cloaks and are soon sound asleep.

The first thing to be seen of El Jowf as it is approached from the north is the great castle which rears its head high above everything else in the oasis. This building, which is circular in form, bears the name "Marid," and the ignorant Jofees believe that a large amount of valuable treasure lies hidden somewhere in the castle, but they are helpless to locate it.

This castle was at one time the stronghold of El Jowf and is no doubt of Arab construction, but as there is no use for it at the present time it is falling into decay. I was not allowed during my stay in the Jowf to go into the castle, although I took a very good photograph of it.

El Jowf is unlike other Arabian cities in that it is long and scattered, most of the houses being concealed among the palms, thus making it very difficult to estimate its size or the number of its dwellings. The city is probably two miles long and about a quarter of a mile wide.

The houses are all built of mud sun-dried bricks; many of them are three stories high, and all have flat roofs. The interior is quite void of furniture, the coffee roaster, pounder, pots, and

A PRIMITIVE DOOR IN JOWF

In the absence of lumber throughout Arabia, palm tree trunks are used for the construction of doors. Although rude in form and appearance, they answer the purpose for which they are made.

cups being about all that is visible that savors of daily life and needs. Most of the houses are doorless, accounted for by the scarcity of suitable wood. The only doors I saw during my stay were those that barred entrance into the palm groves and gardens. These were interesting because of their rude and primitive construction, being made of part of a palm trunk split down the middle and held together with strips of hide.

The abundant and luxurious date-palm plantations are explained by the number of deep wells that are found all over the Jowf from which a never-failing supply of water is drawn. The life-giving liquid is drawn to the surface in huge skins fastened to a rope attached to a camel

THE OVERCOAT OF ARABIA

A large coat of goats' or camel hair is the possession of every man in Arabia. It serves for blanket at night

that walks to and fro, thus raising or lowering the skin bucket. The water is emptied into pools and conducted through surface channels to the groves and gardens. The natives have an understanding among themselves as to the days and time allowed each one to draw water and irrigate their plots.

The population of the Jowf is a subject of speculation; some place it as low

ARABIAN WOMEN CHURNING BUTTER

Butter is made by shaking the milk in skins slung from a tripod or rolled to and fro on the earth. Both methods are shown in the illustration

SKINS FILLED WITH WATER

Zinc buckets are unknown in Arabia, hence the necessity for the water skin. These are used all over the land; they are home-tanned and if cared for and handled carefully will last a long time.

THE COFFEE-MAKER

The Arabians drink only the finest coffee, served in tiny cups. In most guest rooms and tents there is a coffee-maker who prides himself on the excellence of the beverage he can produce.

as 3,000, others much more. When I was there the chief told me he took tax from 40,000 men.

Jowf is noted for the variety, quality, and abundance of its dates, the cultivation and care of the palm giving employment to thousands of the natives. Thousands of camel loads of dates are sent annually to Damascus to be exchanged for goods suitable for barter among the Bedouins and Arabs.

I was interested in learning the many uses that the different parts of the date-palm were put to, including even the stones. As already stated, the trunk is split in two and made into doors, the fiber is woven into ropes and nets, the green fronds are split asunder and plaited into mats and baskets into which the dates are packed for export, and the stones, which are gathered off the floors of the people's houses, are soaked in water and when sufficiently soft mixed with meal and given as feed to the camels, on which they thrive very well indeed.

The dates ripen early in December, and the harvest continues until the end of January. The huge bunches are hacked off with a primitive saw or hatchet and then lowered by means of a rope to men waiting beneath, some of the bunches being as much as an ordinary man can well carry.

Another production of the Jowf much sought after is the abba or large outer cloak of the Arab. These are made entirely of camel's hair, spun and woven both by men and women on the most primitive looms imaginable, and the marvel is that they are able to turn out such well-made goods. In the markets of Jerusalem and Damascus the abba of the Jowf sells at a high price.

DAUGHTERS OF THE DESERT

The Bedouin women have the advantage of their city sisters in the free life they enjoy. Their faces are never veiled and their physical condition is better. The above are typical of thousands who live on the Plain of Arabia.

CARVED DOORS AT HODEIDA

The fine carving on doors and windows is about all that is of interest in this South Arabian port. No such work is done now-a-days, as the art of carving passed out with the last generation. Such work is worthy of preservation in a better place.

THE PORT OF HODEIDA, IN SOUTH ARABIA

The principal landing place for Yemen. All merchandise is landed in the way shown above, to the loss of the merchant, as the bales are frequently let fall into the water or soaked by the incoming tide.

The staple food of the Jowf is dates and temmin, the latter a cereal much inferior to rice, but raised in the oasis, as are grapes, apricots, plums, citrons, melons, tomatoes, cucumbers, beans, pumpkins, and a variety of other things foreign to the Occident.

Newspapers, mails, or telegrams never trouble the Jowfees, and of course machinery in any shape or form is unknown, as are also vehicles on wheels or railroads.

The reader will naturally conclude that a people so isolated from the world must of necessity be superstitious, ignorant, and fanatical, and in all these respects the Jowfee excels.

While I was in the Jowf, and after some trying and not altogether satisfactory experiences with the chief, a high tower, part of that dignitary's castle, fell in, badly crushing and wounding him, so that his life was despaired of for several days. Hundreds of the men and women believed that I was the sole cause of the accident and circulated the report that "with my evil eye I had affected the tower and caused it to fall," and so scared was the chief himself that he preferred ending his days with broken limbs rather than have me near him to set his bones, which he did.

Another thing that was noticeable at the Jowf was the extreme zealousness of the people in their religious observances, even the boys giving heed to the appointed hours of prayer. I noticed, too, that, unlike cities in other Mohammedan lands, there were no mosques, the gathering places for prayer being a large space enclosed on three sides by a high wall, roofless, and void of all ornamentation.

El Jowf is tributary to Ibn Rasheed, and is controlled by a chief who holds office as long as he proves himself capable and turns in the annual poll tax levied

A TYPICAL BEDOUIN CAMP

The tents are made of goats' hair. At night the stock of the Arabs is sheltered in the inclosure and fierce dogs guard the camp. One tent is set apart for the entertainment of guests

A BEDOUIN TENT

The home of the Bedouin is made of goats' hair cloth, spun and woven by the women. It is very durable and portable and forms a good protection in all kinds of weather

AN ARAB SHEIKH

on the men under his jurisdiction. The official residence of this important person is a most uninviting place, being a series of rooms enclosed by three high walls with intervening courts. On each corner of the outer wall is a tower some 30 feet high, from which an outlook is kept across the desert in all directions.

Wheat or barley bread is eaten as a luxury in the Jowf, a kind of bread being made from a small seed known as semmah, much in appearance like red sand and very unpleasant to the uncultivated taste. This seed is gathered off a small bush that grows wild in and about the oasis.

About all that is known of the country between Jowf and the Persian Gulf has come to us through the writings of Palgrave, Blunt, Doughty, and Euting, all of whom traveled through the central and eastern parts of the peninsula. Since these were in the land so many changes have occurred that the modern traveler would find much fresh material to record, while photographs of that land are as yet practically unknown. Here, then, is a field for those who are ambitious to do something unusual.

Yemen in the south is difficult of approach owing to the extreme jealousy of the Turks on the coast.

The principal port of Yemen is Hodeida, reached by coasting steamers from Aden. The condition of this port has been a subject of much discussion between the Powers and the Turks, the latter preferring the difficult approach to anything that savors of improvement, or that would facilitate trade or encourage the native to better his condition.

All steamers arriving at Hodeida have to lie out in the open roadstead, while the cargo is landed in small boats. Even these cannot unload alongside the quay, the bales and boxes being carried ashore on men's shoulders. Both man and burden are often deluged by the incoming tide and huge waves, much to the detriment of the merchandise and serious loss of the trader.

Hodeida has little to attract, things ancient being conspicuous by their absence. About the only things of interest in this Arabian port are some finely carved doors which adorn several of the residences. The art of such carving has passed away, none of the present inhabitants being able to do such work, although they appreciate and admire what their grandfathers did in the times that are gone (see page 1056).

From Hodeida goods are transported into all parts of Yemen, mainly on mule back because of the mountainous nature of the country.

Another port of Yemen that once claimed attention is Mocha. From it large quantities of the finest coffee used to be exported, but owing to the increased taxation, heavy export duties, and robbery by the Ottoman officials the Mocha coffee business is largely a thing of the past.

A large exportation of dates, rawhides, spices, and mother-of-pearl is carried on from the ports of the Persian Gulf, with a little more encouragement and protection to the native by reason of the strong British influence in those parts.

Wherever people are found in the Arabian peninsula with the most limited number of milk-giving animals, such as sheep, goats, or camels, there will be found the national substitute for the lard of the Occident or the olive oil of other lands, a very favorite production called "semmin."

This is a butter which is made in primitive, simple, and unappetizing manner by being churned in a skin which has been none too well cured and does not recommend itself for cleanliness. The mode of procedure is simplicity itself, the milk being put into the skin and then either swung backward and forward on a tripod, or rolled to and fro on the ground, until the fat of the milk forms itself into butter. A favorite dish to set before a distinguished guest is a mixture of dates and butter.

Another interesting fact about the Arabian people is their complete abstinence from all kinds of intoxicating drinks. Many little etiquettes are observed in connection with the serving of

the national beverage, coffee, such as the host tasting the coffee himself ere he offers it to his guest, or the filling the tiny cup more than a third full, or offering a third drink, which is equivalent to asking your visitor to leave your house or tent.

As regards the great and almost unknown interior little of any certainty can be written. In the central region known as Nejd are quite a number of large cities, such as Hayil, Boreida, Anezea, El Riath, Dooreayah, with numerous smaller towns, villages, and settlements within easy distances, to say nothing about the extensive camps of the Bedouin, who own allegiance to the Emir in the capital.

These latter are probably the more numerous of the peoples of the peninsula, and by far the most interesting class of the two. The Bedouin pities the city dweller because fate has decreed that he must pass his days in the confinement of a house or enclosed city, while the city man congratulates himself on his good fortune in being spared the dangers, inconveniences, and exposures that are the lot of the tent-dweller.

The life of the latter is an uncertain one. His tent is home made, spun and woven by the women of his harem from goats' hair, the accumulation of many years. This tent cloth is waterproof and a good protection against the fierce sun of the desert. It is very portable and serves for many generations. Each camp has its chief, part of whose tent is set apart as the guest room, in which visitors are entitled to three days' hospitality. The chief also gives the order to move camp and decides on the new pitch. Local disputes are referred to him for settlement, and in the event of his being unable to adjust the matter the disputants must go to the capital and present their case to the Emir. This they are slow to do, as it means a long journey and absence from home for an uncertain time, as well as some amount of expense. The chief, too, is responsible for the good behavior of the people in his district and for the return of the tax due from his tribe.

Throughout Arabia there are many things in common among both classes of the people, viz., the manner of clothing among both sexes; little distinction is made between the rich and the poor, and from a man's clothes no idea could be gotten of his social standing.

In all homes it is customary for the host to assume the place of waiter during the serving of food, taking his meals after all the others have been served.

As in other Mohammedan lands, the women in the cities and towns of Arabia are secluded, but in the village and camp life they enjoy the same freedom as the men; the women, too, do a large share of the work in coöperation with the male members of their families.

The great need of the Arabian peninsula is water, for without that all-important factor of every-day life little can be accomplished, and the entire absence of running water in any shape or form accounts largely for the lack of any forward movement or attempt at industrial or manufacturing achievements.

Where water is obtainable it is generally from wells of great depth, causing a large amount of labor to get it to the surface. Some of these wells are evidently ancient, as evidenced by the stones of many courses near the mouth and the deep grooves worn by the ropes of the drawers during many centuries. Some of these grooves are as much as nine inches deep in stone as hard as marble.

Enough has been told in these pages to give an intelligent idea of the "desert of the sea," and to demonstrate that here remain fresh fields for exploration, research, discovery, and possible adventure. For any attempting such an expedition it is hardly necessary to say that a knowledge of Arabic is essential in order to get at facts and a reliable record of things past and present.

The field is open to all. Any one who can bring to the civilized world some information on central and southern Arabia will add valuable data to the geography and literature of the day.

A COUNTRY WHERE GOING TO AMERICA IS AN INDUSTRY

By Arthur H. Warner

WHILE on a visit to Piana dei Greci, an Albanian settlement on the mountains 12 miles out of Palermo, I asked what the leading industries of the place were.

"Agriculture and emigration to America," was the reply.

The answer would be equally true of all that part of Italy which lies south and east of the city of Naples, including Sicily. It is this region—whose people are the most untutored and whose land is the least developed in the kingdom—that for almost a score of years has been pouring its lifeblood into the United States, until it has given us a population of some 2,000,000 Italians, and brought it about that at least every eighth man, woman, or child in the city of New York is of that race.

In my effort to see the Italian emigrant as he is at home, I went first to Sicily, partly because of the magnitude of the exodus from that island within recent years—110,477 annually from 1905 to 1908—and partly because, of all his race, the Sicilian has as yet the fewest friends in America. There was a time in the United States when it was customary to condemn Italian immigrants *en masse*. Later it became the fashion to assert that, while the northern Italians might be desirable, those from the south were otherwise. Still more recently it has come to be said that some southern Italians might be all right, but the Sicilians are a dangerous and lawless set, responsible for the "Black Hand" outrages and other crimes among their people.

One of the first localities I visited while making my headquarters at Palermo was Termini, a seaport 25 miles to the eastward, with a reputation for making the finest macaroni in Italy. I had heard it spoken of as an "American town" and, inquiring the reason, it was explained that the leaven of emigration had worked so powerfully there that half the population was in America and the rest was likely to go before long.

"You will see many women there," I was told. "You will find them keeping the shops and doing the work which there are no longer any men to do."

And so it proved.

The population of Termini, I was informed by residents, was about 25,000, by comparison with a number nearly twice as great when the emigration movement set in 15 years ago.

"But it has helped the town," they continued. "There are fewer people here now than once, but more money. Capital that has been earned in America has been invested here and the city was never more prosperous. Some 200,000 francs a month come back from townsmen in the United States and the principal bank here holds 8,000,000 francs against the names of emigrants who are at work in America."

Come with me through this island of Sicily somewhat and see if its people are the degenerate and undesirable sort that they are frequently pictured. From Palermo, on the north coast, situated in a wonderful valley of lemons and oranges known as the Conca d'Oro (shell of gold), we will go south through the interior to the blue rim of the African Sea where stand the golden brown temples, which the Greeks reared at Girgenti 2,500 years ago, and then back into the sulphur country and eastward to Mount Ætna.

The lemons and oranges which are so great a part of Sicily's wealth we lose soon after leaving the coast, for they must have water, and it is not to be found in this treeless interior. In their stead are groves of olives and almonds and fields of barley and beans, which last

Photo by Arthur H. Warner

STREET SCENE: TERMINI, SICILY

play as important and varied a part in the diet of Sicily as do potatoes with us, while the untilled stretches are crimson with patches of sanfoin, and dotted with wild poppies, morning glories, and yellow clusters of the fiori di maggio (flowers of May). One misses here even the spreading stone pines of Naples and, except for an occasional cypress, scarcely a shade tree is anywhere to be seen, the forests long since having been ruthlessly destroyed, much to the detriment of the land and the present generation.

In the heart of the sulphur region it becomes more desolate. Nothing seems to grow here. Even at this season, the springtime, the valleys and hillsides look old and weary and in summer they parch up like a desert. To make matters worse, the surface is torn up by mines and the waste dirt is piled about in ugly, forbidding heaps which lie like a blight upon land already poor enough.

Mining may be a necessity, but at best it is only a necessary evil. It destroys nature and despoils the earth just as agriculture preserves and uplifts it. And so, too, with men. The one occupation seems to degrade and brutalize just as the other broadens and uplifts those who engage in it.

The miners in the sulphur country work from six in the morning until seven at night, with an hour off at noon, for from 40 to 60 cents for a full day, but do not work Sundays and usually half time only three days out of the six; so perhaps $2.50 would represent an average weekly wage.

No wonder men leave such a life, even for the tenements of Elizabeth Street, or the mines of the Alleghanies. At the time of my visit to Sicily, emigration was almost at a standstill. Yet, even so, one encountered bands off to the new land.

I shall not soon forget the first party of departing emigrants I saw. It was at a dreary little station in the sulphur belt, and the moment the train drew in one might know that some great event was taking place by the crowd of women, some gnarled and seamed with the years like the olive trees of the hillsides, who gathered on the platform, each one with her black *manto* drawn close about her head.

The train stopped and the guards opened the doors with a mighty clattering. Half a dozen young men, with a hurried look backward, jumped into the nearest compartment, dragging or push-

ing their worldly all in huge bundles as they went.

"Pronti! Pronti!" shouted the conductor, and the doors were banged shut again as mothers, wives, sisters, or daughters stood weeping and clinging to the ones they loved.

The *capo di stazione* sounded his bell, the engineer answered with a toot of the whistle, "Pronti! Pronti!" roared the conductor again, and the train was off, leaving in a cloud of dust the miserable group of women huddled in front of the forlorn station whence the stronger ones had departed to return—who knows?

Let us leave this desolate sulphur region and climb the heights to Castrogiovanni, a town of 25,000 inhabitants, on the flat top of a hill half a mile above the valley below. It and Calascibetta, a twin city on a corresponding peak a couple of miles across the valley, are two of the most picturesque places on the island. To protect themselves from the fog and cold of the high altitude the men of Castrogiovanni, like those of other mountain towns in Sicily, wear hooded cloaks, resembling the Moorish gelab, probably a survival of Saracen days in Sicily. They are a clear-eyed, clean-skinned people, honest and courteous in their dealings, and unspoiled by tourists or contact with the world beyond. Scarcely among such can one find the criminals and depraved that he has heard of as springing from Sicily.

Photo by Arthur H. Warner

IN THE PUBLIC SQUARE: CASTROGIOVANNI, SICILY

The hooded cloaks are probably a survival of the Moorish gelab of Saracen days

On my first afternoon in Castrogiovanni, while strolling down the main street I was accosted in good English by a man who recognized my nationality and told me that he had lately come back from America, after working there two years as a barber. His mother's health had gone to pieces and the doctor had advised him to return to Sicily with her, although he was doing well in America financially.

"Money is money," he said, somewhat

PIANA DEI GRECI

One of four settlements made in Sicily by Albanians in the fifteenth century

Photos by Arthur H. Warner

STREET SCENE: SETTINGIANO, CALABRIA

A SICILIAN ROAD

Photo by Arthur H. Warner

Showing the giant cactus or prickly pear used for hedges on either side

COUNTRY SCENES IN SICILY

Photos by Arthur H. Warner

A SICILIAN YOUTH

The illustrations on pages 1069–1095 are all from photographs by W. von Glöden, of Sicily, who for many years has been trying to portray in photographs the variety of race and romantic charm of that island "where going to America is an industry."

CARE-FREE CHILDREN OF SUNNY SICILY

YOUNG SICILIAN BOYS WHO PERHAPS SOME DAY WILL BECOME AMERICAN CITIZENS

A SICILIAN CART (SEE ALSO PAGE 1102)

The gaudy coloring of the Sicilian cart and the picturesque allegories painted upon it fascinate and puzzle all visitors to Palermo. Incidents in the life of Ulysses, of Achilles, of Olympian gods and demigods, battles of the pagan deities and Christian saints, of the Crusaders and Saracens, and countless other historical and mythical subjects are represented in glowing colors and usually with considerable skill.

BOUND FOR THE MARKET: PALERMO, SICILY

WHAT SHALL WE DO?

A CHILD OF SICILY

A COMMON SCENE IN SICILY: THE STREET COBBLER AND THE TELLER OF PARABLES

VILLAGE LIFE IN SICILY

A PASSION FLOWER

A FAIR FORTUNE TELLER

LITTLE SWEETHEARTS

LOVERS

ANOTHER TYPE OF SICILIAN

In no other section of Europe can such a blend and variety of race be found as in Sicily. Perfect specimens of the Saracen, the fair-haired Norman, the Arab, the Greek and the Roman, the Carthaginian, the Crusader from many lands and of almost every ancient and modern race (excepting the yellow and Indian) may be seen on the streets of Sicilian cities.

WATCHING MOUNT ETNA

IN THE PHILOSOPHER'S GARDEN

THESE SICILIAN GIRLS MIGHT ALMOST BE CALLED DAUGHTERS OF ANCIENT CARTHAGE

A MAIDEN'S PRAYER

A SICILIAN BELLE

IN OLD SYRACUSE

ROMEO AND JULIET IN SICILY

A SICILIAN TROUBADOUR

DREAMING: A SINGER OF OLD SICILY

SUMMER TIME IN SICILY

A SHEPHERD AND HIS LUTE UNDER THE ALMOND TREES: TAORMINA, SICILY

HAPPY HOURS IN SICILY

CHUMS

Photos by Arthur H. Warner

CALABRIAN GIRLS

A WEDDING IN CALABRIA: THE BRIDE IS IN THE CENTER

wistfully, "but mother is mother," he added, with conviction.

He thought that if he could work at his trade ten years in America he could save in that time $2,000 and with it return and buy a farm in his native land.

From Castrogiovanni one sees towering fifty miles to the eastward the cone of Mount Ætna, rising out of the valley of Catania symmetrical and majestic. One who would know Sicily should not neglect a visit to its slopes, whose volcanic soil, fresh from the inwards of the earth, grows the finest grapes of the island.

Everywhere you go among its splendid people, if merely to ask a direction or say good afternoon, you must stop and drink of their proffered wine, and you will conclude that you have again come to the wrong place to look for thieves and cutthroats.

From Sicily I passed up into Calabria, the most southerly division of the peninsula, the heel of the boot of which Sicily constitutes the toe, and, although it is geographically nearer Naples and the northern centers than the island below it, it is in fact the most isolated part of the kingdom. Communication throughout it is most difficult because of the lofty and rugged peaks of the southern Apennines, while there are few steamships and fewer railroads.

Figures compiled by the Italian government show that for the three years 1905–1907 emigration from Calabria averaged annually 394 persons for every 10,000 inhabitants—greater proportionally than from any other part of the kingdom. Of these, 385 crossed the Atlantic, and, although there are no statistics to show how many went to South and how many to North America, it is known that practically all the Calabrian emigration comes to this country.

Calabria is a region unknown to the tourist, and yet, without knowledge of Italian, an English-speaking man might get along better there than elsewhere in Italy because of the great number of emigrants returned from America with a fair knowledge of its language. These one meets with most, not in the larger cities, but in the villages, because the population of the last is made up almost entirely of agricultural laborers, and it is from this class that emigrants are made.

Take, for instance, the little village of Settingiano, a hill town which I visited one day from Catanzaro. The first man I met I addressed in Italian, but, after a sentence or two in that language, he divined my nationality and answered me in excellent English. After that it seemed to me that I must be back in America so far as the men went, so many of them came up and talked to me in English.

With the women it was otherwise. They were Italian of the primitive sort. All dressed in the beautiful old Calabrian costume and walked barefoot through the streets, carrying their big water casks to and from the fountains on their heads as if they had stepped out of another century.

That day at Settingiano was one of the pleasantest of my Italian experiences. Probably I was the first American who had ever visited the town and, interested as I was in what I saw, I was less a spectator than an exhibition. The people turned out to see me as in an American village they would for a circus, followed me about, and, in a friendly if curious spirit, tried to make my visit agreeable. By happy chance there was a wedding, which I was invited to attend, and, when I left to catch a train back to Catanzaro, four boys insisted on accompanying me a mile to the station, while one of them stopped at his home on the way and picked me an immense bunch of flowers from his garden.

I suspect my visit gave an impetus to American emigration in that town such as it never had before, but if so prepossessing and kindly a people should move their village over tomorrow, bag and baggage, I imagine we would be better rather than worse off for the arrival. All of the returned emigrants that I talked with said they were back in the old country only for a time and expected to go to the United States again when times improved.

"We're glad to be back awhile to see the old place once more," one of them explained to me, "but wait until times are good in America again and you'll see the biggest rush from Italy that has ever taken place."

Leaving Calabria and traveling north toward Naples through Basilicata, I found similar conditions. In the larger towns and among the upper classes neither our language nor our ideas are understood, but one need go no farther out of Potenza, the provincial capital, than the vineyards on the side of the hill upon which it is built to find men working in the fields who are ready to talk to you in your own language and welcome you as a friend when you tell them that you are from the United States.

Now what impressions does one get of the Italian emigrant after seeing him thus in Sicily and in the southern provinces of the mainland whence the westward stream comes?

The point that struck me first was that Italy was not overpopulated. There is an impression in this country, I know, that it is, in which I myself shared until I traveled through it and studied the figures. Italy has about 30,000,000 inhabitants, but Germany and Great Britain, with about the same area, are supporting populations in each case of twice that size and doing it better into the bargain. Besides that, the greatest density of population in Italy is to be found in the north, where prosperity is highest and emigration least.

The difference is that Italy is still trying to support her population by agriculture, whereas Germany and Great Britain have long since seen the necessity of working out their destinies through manufacture and trade.

Moreover, Italy is a backward country agriculturally, which may come as another disillusionment to many who have heard of its wonderful vineyards and olive groves, of the marvelous patience and labor that are put into reclaiming rocky slopes, and fighting inch by inch with nature for every possible bit of soil. But this is true of certain localities only. The environs of Naples, the Conca d'Oro of Palermo, the slopes of Mount Ætna are indeed examples of intense and intelligent cultivation, but, on the other hand, there is much land in south Italy wasted and misused, and great stretches, like the splendid valley along the Ionian Sea from Catanzaro to Metaponto, where they are putting in twice as much work and getting half as large a return as if that same land were in France or Switzerland.

The wooden plow is still in use in many places in Italy, and modern farm machinery is practically unknown in the south. Everything is done by hand at a tremendous expenditure of human labor, which might be more productively employed, while the use of fertilizers or the rotation of crops is not understood.

The root of the trouble is the land system. The whole of south Italy is an agricultural country, and yet one may almost say that there is not a farmer in it, as we understand the word here. There are land-owners on one hand and agricultural laborers on the other—that's all. The landlord idles away his time in the cities. Such a thing as living on the land, getting out in his shirt sleeves to work it, and hiring others to help him when necessary is unheard of. Frequently he never even visits his estate, but leaves everything to a chain of middlemen, each of whom wrings an unearned living out of the peasant below.

And the agricultural laborer? He works twelve hours each week day and frequently half of the Sabbath at an impossible wage—about forty cents a day for a man and half that for a woman—or for a miserly share of the produce, without proper tools or adequate instruction. He does not live on the land any more than its owner, but, through a habit acquired in the old days, when it was necessary to keep together for protection against outside attack and for fear of the malaria in the lowlands, he huddles with others in dirty, unsanitary towns on the hilltops, where houses are built as close together and he is as cramped for room as in the city of Naples.

The principal difference between that,

CALABRIAN GROUP

Photos by Arthur H. Warner

AT A STREET FOUNTAIN: SELTINGIANO, CALABRIA

the metropolis of the country, and a tiny Italian village is that the houses in the first have five and six stories and in the other only one or two. Living conditions are similar.

This very menace of malaria proves the backwardness of agriculture. The disease is unknown where proper drainage and thorough cultivation exist. There was no malaria in the Campagna in Roman days. It is only since the valley about the Eternal City has been allowed to fall back into disuse and neglect that it has become a breeding-place for mosquitoes and a pesthouse of disease.

The trouble with Italy, particularly the southern provinces, is that there is no middle class. You have the upper class, living in idleness and greater luxury than the nation can afford, and the peasant toilers under them, obliged to support this top-heavy fabric and an expensive army and navy besides by lives of hardship and deprivation.

There is a popular belief in America that, although wages are low in Italy, the cost of living is so much less as to make the proportion between the two much the same as with us. This is based on a misconception. A comparison of prices there and here will reveal only slight differences *provided an equal quality is obtained.* It is the *standard*, not the *cost* of living, that is lower there than here. The average American who gets the impression that Italy is a ridiculously cheap country in which to live is used to an unnecessarily high standard at home, and, going abroad, accepts unconsciously a lower one without discomfort.

As an Italian who had been in the United States said to me in a train in Sicily, "In America, cost much to live, but everything good. Down here, everything cheap, but not much good, too. Italy is a good place to live, you have money. No money, not much good."

What Italy needs is a revolution in its land system such as was begun a score of years ago in New Zealand, when John Ballance and the Progressive Party went into power. If the government could start in buying up some of the disused and misused estates in south Italy, divide them up, and rent small holding at fair figures, it would give the Italian *contadino*—thrifty, industrious, and simple man that he is—a chance to become a farmer instead of a mere farm laborer. In conjunction with this a system of agricultural schools and stations should be developed to teach him how to farm, the means of transportation should be improved, and government education should be extended so that his children may know some of the things to which his eyes are sealed.

Is such a solution to be hoped for? In the near future, it must be admitted, it is not. The present Italian government, progressive as it is in many respects, cannot be expected to take a radical stand on the land question. American ideas are helping, just as American dollars sent back by the emigrant are helping to improve conditions. The exodus of laborers has already raised wages in many sections, and the landlords are aware of the danger that has come to south Italy through the loss of thousands of its young and ablest workers. Yet little is to be expected of them, steeped in selfishness and tradition as they are, and not much more is to be expected of the peasants themselves in the lives of superstition and ignorance to which they have been reduced.

Of an Italian boy, perhaps eighteen years old, whom I met high on the slopes of Ætna I asked the name of the owner of the land upon which he was working.

"Il padrone," he answered.

"And what is the padrone's name," I continued.

He shook his head blankly. "I don't know," he answered.

The question must become a national one and be taken up by the government in a systematic and adequate way, and that will require time. New ideas are stirring in Italy. I was surprised to find the strength of Socialism there, and while I was in Italy there was a serious and bitter strike of the agricultural workers in Parma and similar disturbances in

Photos by Arthur H. Warner

POTENZA BASILICATA

BASILICATAN PEASANT'S HUT

Used as a day shelter only, the workers returning to town at night.

SICILIAN CART Photo by Arthur H. Warner

Pictures are painted on all vehicles and the horse wears a variety of charms to ward off the "Evil Eye." (See also page 1078)

Puglia, but south of Naples the vast army of the *contadini* is as yet untouched by new thought—or indeed any thought—on industrial questions.

Better conditions in Italy still appear somewhat remote, and in the meantime the outflow of laborers, once started, will continue. Those who have elected to believe that the portion of this which comes to America is "the scum of Europe" will doubtless hold to that view in spite of anything which persons who have learned to know the Italian peasant, either in this country or his own, may say to the contrary.

But it may be well to recall that the same arguments that are used against the Slavic and Italian arrivals of this day were urged with equal vehemence against the Teutonic and Celtic immigration when it had its beginnings fifty years ago. As events have already disproved these fears in one instance, so in time they may in the other.

NOTES ON TURBULENT NICARAGUA

THERE is no spot of equal area upon the globe in which so much human blood has been wasted in civil war or so much wanton destruction committed. Nature has blessed it with wonderful resources, and a few years of peace and industry would make the country prosperous beyond comparison; but so much attention has been paid to politics that little is left for anything else. Scarcely a year has passed without a revolution, and during its sixty-five years of independence the Republic has known more than five times as many rulers as it had during the three centuries it was under the dominion of Spain. It was seldom a question of principle or policy that brought the inhabitants to war, but usually the intrigue of some ambitious man. It is a land of volcanic disturb-

Photo from Mrs Harriet Chalmers Adams

METHOD OF BUILDING RAILROADS IN THE SWAMP LAND OF NICARAGUA

ance, physical, moral, and political, and the mountains and men have between them contrived to almost compass its destruction."*

Nicaragua, the largest of the Central American Republics, extends over an area of 49,200 square miles, equal to that of the State of New York, with a population estimated at about 600,000.

Two mountain ranges traverse its entire territory. Due to this fact it enjoys a diversity of climate, products, and soil. The fertile plateaus are extremely healthful and pleasant, but the lowlands are hot and tropical. Coffee, cacao, and bananas are the principal articles of export, but sugar cane, tobacco, cotton, maize, and wheat are successfully grown. Numerous minerals and precious metals are found in the mountains. The vast forests contain over forty different species of trees furnishing oils and extracts used for industrial and medicinal purposes—mahogany and other valuable cabinet woods.

In the depression in which are situated the picturesque lakes Nicaragua and Managua are extensive plains affording excellent pasturage for cattle, and it is in this part of the country that most of the larger cities are to be found. The east coast, commonly known as the Mosquito coast, is but sparsely settled. The Indians inhabiting the Mosquito country are noted for their unique industries, such as the manufacture of various kinds of jewelry, especially the so-called Panama gold chains, hammocks, straw hats, and pottery, all of which find a ready market.

Columbus, on his fourth and last voyage, in exploring the coast of Central America, and after touching at Cape Honduras, was driven by the stress of weather to take shelter where the coast line turns abruptly from west to south.

*From "The Capitals of Spanish-America," by W. E. Curtis.

CENTRAL AMERICA
with special reference to
NICARAGUA
Longitude West 85° from Greenwich
MEXICO
GUATEMALA
HONDURAS
BRITISH HONDURAS
SALVADOR
NICARAGUA
COSTA RICA
PANAMA
COLOMBIA
Belize
Gulf of Honduras
Tegucigalpa
Guatemala (la Nueva)
San Salvador
Lake Nicaragua
Greytown (San Juan del Norte)
San José
Pico Blanco
Chiriqui Lagoon
Bocas del Toro
Chiriqui Gulf
Gulf of Darien
Caribbean Sea
Pacific Ocean
Panama Canal under construction
THE ISTHMUS OF PANAMA
Colon
Panama
Chorrera
Pearl Is.
Bay of Panama
Old Providence I. (To Colombia)
St. Andrews I. (To Colombia)
Corozal
Chetumal Bay
Ambergris Cay
Turneffe I.
Lighthouse Reef
Swan Islands
Bay Islands
Roatan I.
Bonacca or Guanaja I.
Utila I.
C. Honduras
Cameron
Caratasca Lag.
Mosquito Coast
Gulf of Fonseca
Gulf of Nicoya
Gulf of Panama
Gulf of Mosquito
Gulf of Urabá
Mountains
Volcanoes
Lakes
Rivers
Capitals
Towns
SCALE OF MILES
KILOMETERS

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GOVERNMENT RAILWAY STATION: GRANADA, NICARAGUA

Granada is the southern terminus of the railway system of Nicaragua, which amounts altogether to about 150 miles, connecting the Pacific port of Corinto with Leon, Managua, and Granada. The public roads are very bad at all times and in the rainy season are impassable. There are steamers on Lakes Managua and Nicaragua, and also flat-bottomed steamers on the San Juan River between Lake Nicaragua and Greytown (San Juan), on the Mosquito Gulf. Thus there is steam communication by rail and water between Corinto on the Pacific and Greytown on the Atlantic side. The station at Granada is a very attractive structure and would be creditable to any city of its size. The present population is 20,000.

This point, which he named Cape Gracias a Dios (Thanks to God), is in Nicaragua, and it has retained ever since the name given by Columbus. On September 25, 1502, he landed and took possession of the country in the name of the Spanish Crown.

In 1524 Hernandez de Cordoba was dispatched from Panama to bring the country under subjugation. This he did, defeating the Indians and making several settlements. Some years prior to this Gil Gonzalez had explored the country, and had discovered Lake Nicaragua. In 1570 Nicaragua became a part of the captain-generalcy of Guatemala.

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THE SMOKING TERROR: MOMOTOMBO VOLCANO, NICARAGUA

Nicaragua possesses more volcanoes than any other country of its size. The chain of volcanoes extending along the western coast contains many which have been active in recent times, perhaps the most famous being Coseguina at the tip of the peninsula opposite Salvador. This volcano, after slumbering for centuries, suddenly burst into activity in 1835, covering the country with a pall of dust and smoke for four days. The dust fell over 1,500 miles of land and water extending all the way from Jamaica, in the West Indies, to Bogota, in South America.

Among the numerous invasions which Nicaragua, together with other Central American States, suffered during the sixteenth and seventeenth centuries, those of Sir Francis Drake and Henry Morgan are the most noteworthy. In 1740 the British invaded the Mosquito coast, and, establishing friendly relations with the warlike Misskito or Sambos Indians, who had never submitted to the Spanish invaders, took possession of that part of Nicaragua. They retained possession of this territory until the year 1786, when, by a treaty with Spain, it was exchanged for what is now known as British Honduras, or Belize, and the land was restored to Spain. The Mosquito Indians subsequently acknowledged the sovereignty of Nicaragua.

On the 15th of September, 1821, the independence of the Federacion de Centro-America having been declared in

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THE PICTURESQUE CITY MARKET: MASAYA, NICARAGUA

Masaya, nine miles west of Granada, is near the little Lake Masaya, at the foot of the volcano of the same name. Into the crater Friar Blas, of Castile, in 1534, tradition states, lowered a bucket, that he might draw up molten gold. The bucket melted as it touched the lava, and the monk wrote: "One cannot behold the volcano without fear, admiration, and repentance of his sins; for it can be surpassed only by the eternal fire."

The place is peopled mostly by Indians, about 15,000 in number. Volcanic ash forms the soil of the vicinity, which is very fertile and is planted chiefly with tobacco. Its manufactures were formerly noted throughout Central America, and are still of considerable importance—hammocks, cordage, straw hats and other articles of Indian workmanship.

In the market are sold the products of the orchards, fields and factories. We are most interested in the luscious fruits and the announcement of the women who sell them; it is translated:

"I have oranges, papayas, jocotes,
Melons of water, of gold, and zapotes,
Will you buy?"

Photo from Mrs Harriet Chalmers Adams

MARKET STREET: GRANADA, NICARAGUA

Granada lies a mile or more from Lake Nicaragua with which it is connected by tramway. The country around Granada is extremely lovely; and Lake Nicaragua, the largest body of fresh water between Lake Michigan and Lake Titicaca, in Peru, is frequently pronounced the most beautiful lake in the world. The mountains of Nicaragua and Costa Rica soar on all sides of the lake, and within it rise the twin volcanoes of Ometepe and Madera.

Guatemala City, Nicaragua became a State of the Federation, and with it, in the year 1822, a part of Iturbide's Empire of Mexico. With the fall of the empire it again formed part of the Federation.

Upon the dissolution of the Federation Nicaragua declared its absolute independence on April 30, 1838, and the constitution of the Republic of Nicaragua was formally proclaimed on November 30 of the same year.

Gen. José Santos Zelaya was inaugurated President on April 17, 1906.

In 1906, the latest year for which commercial details are available, Nicaragua's foreign trade aggregated $7,639,877.53, exports accounting for $4,231,047.88 and imports for $3,408,829.65. The United States, England, Germany, and France are the leading factors in this commerce, receiving and furnishing the following amounts:

Exports: United States, $2,492,485; England, $452,142; Germany, $458,718; France, $480,502.

Imports: United States, $1,914,961; England, $776,133; Germany, $400,389; France, $193,661.

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BRONZED-COLORED MAIDENS ASSORTING COFFEE: NICARAGUA

Coffee is the principal agricultural product of Nicaragua, as of other Central American states

Coffee constitutes the leading item of export, 19,378,216 pounds being shipped in 1906, valued at $1,375,679. Bananas occupy second place, with 1,401,595 bunches, valued at $700,069; followed by gold bullion, $527,423; gold amalgam, $343,546; rubber, $385,472; mahogany, $284,320; cattle, $133,044; hides, $120,367; cocoanuts, $90,953; silver coin, $44,220; sugar, $23,467; and cedar, $41,465.

Agriculture and mining are the principal sources of national wealth. The area under cultivation has increased in recent years, the chief product being coffee. Nicaraguan coffee is of superior quality, and commands good prices, the finest plantations lying in the western districts. In Matagalpa and Jinotega the crops are worked by colonies of Americans and Germans, who apply the natural water-power of the country to the operation of such machinery as is required.

Bananas are grown in large quantities in the Bluefields region and shipped to New Orleans. A tract of land about 15,000 acres in extent, growing 100,000 banana plants, is one of the recently granted concessions on the Atlantic coast, and another more extensive grant of land

Photo from Mrs Harriet Chalmers Adams

THE WAY ONE LANDS AT CENTRAL AMERICAN PORTS

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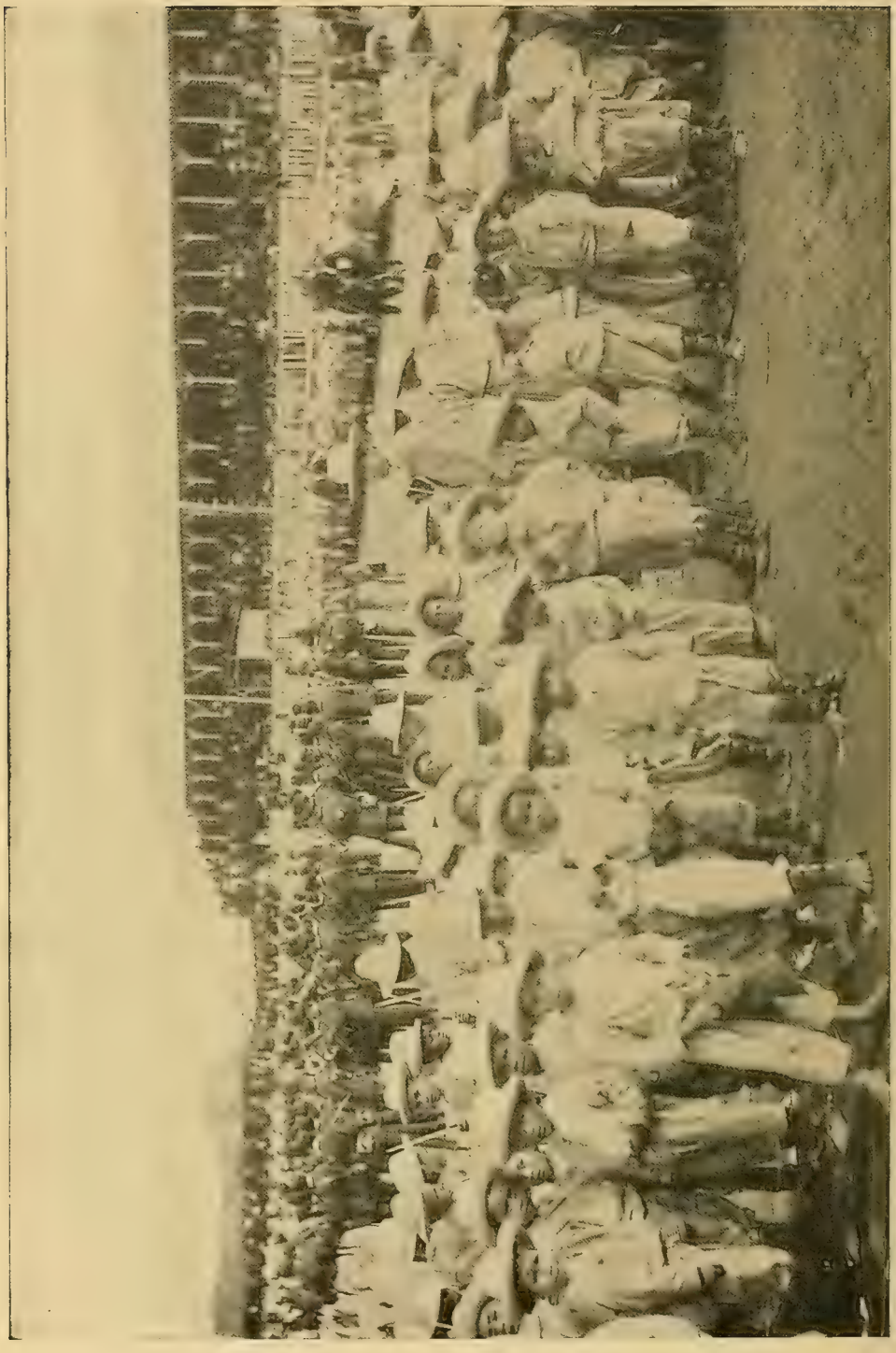
AN ARCHITECTURAL MONUMENT TO THE INTREPID AND ZEALOUS OLD MONKS OF THE CONQUEST: MASAYA, NICARAGUA

is to be opened up on the west coast. The cost of planting and maintaining 200 acres with 35,000 plants is about $4,000.

The hydrographic system of Nicaragua is very extensive, and its numerous rivers, together with its large lakes, give excellent facilities for transportation and communication.

The most important of these is the river San Juan, which has a total length of 140 miles, flowing into the Nicaragua Lake, and by means of which communication is established with the important cities in that region, as well as with the capital itself. A regular triweekly steamship service is maintained on the San Juan River between San Juan del Norte, at the mouth, and the city of Granada, on Lake Nicaragua. From Granada a railway extends to Managua, Leon, and the Pacific port of Corinto.

The river Wanks, or Segovia, is navi-



SCHOOL CHILDREN OF GUATEMALA

Photo from Mrs Harriet Chalmers Adams

MAKING SUN-BAKED BRICKS: SALVADOR Photo from Mrs Harriet Chalmers Adams

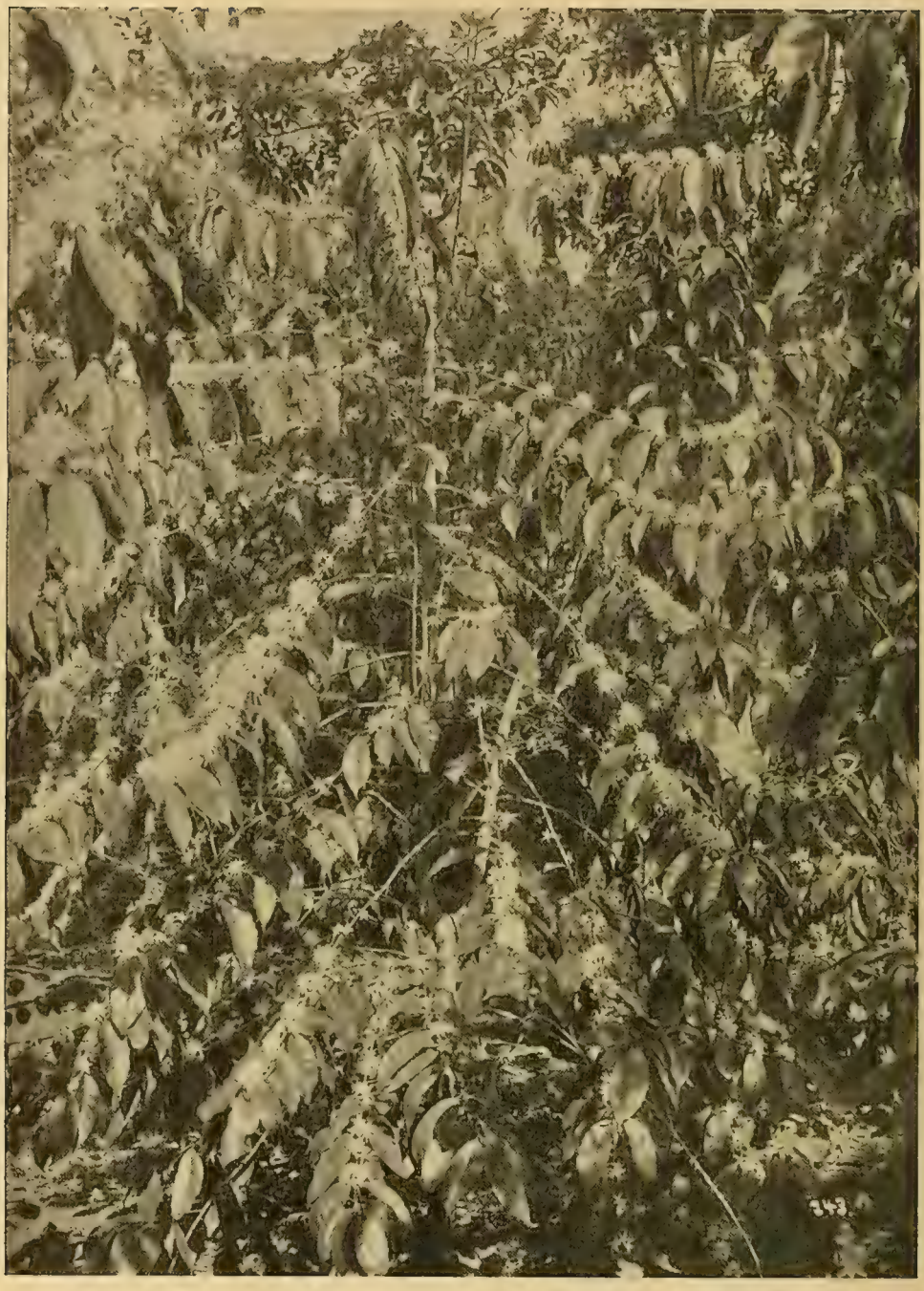


Photo from Mrs Harriet Chalmers Adams

COFFEE TREE IN FLOWER: NICARAGUA

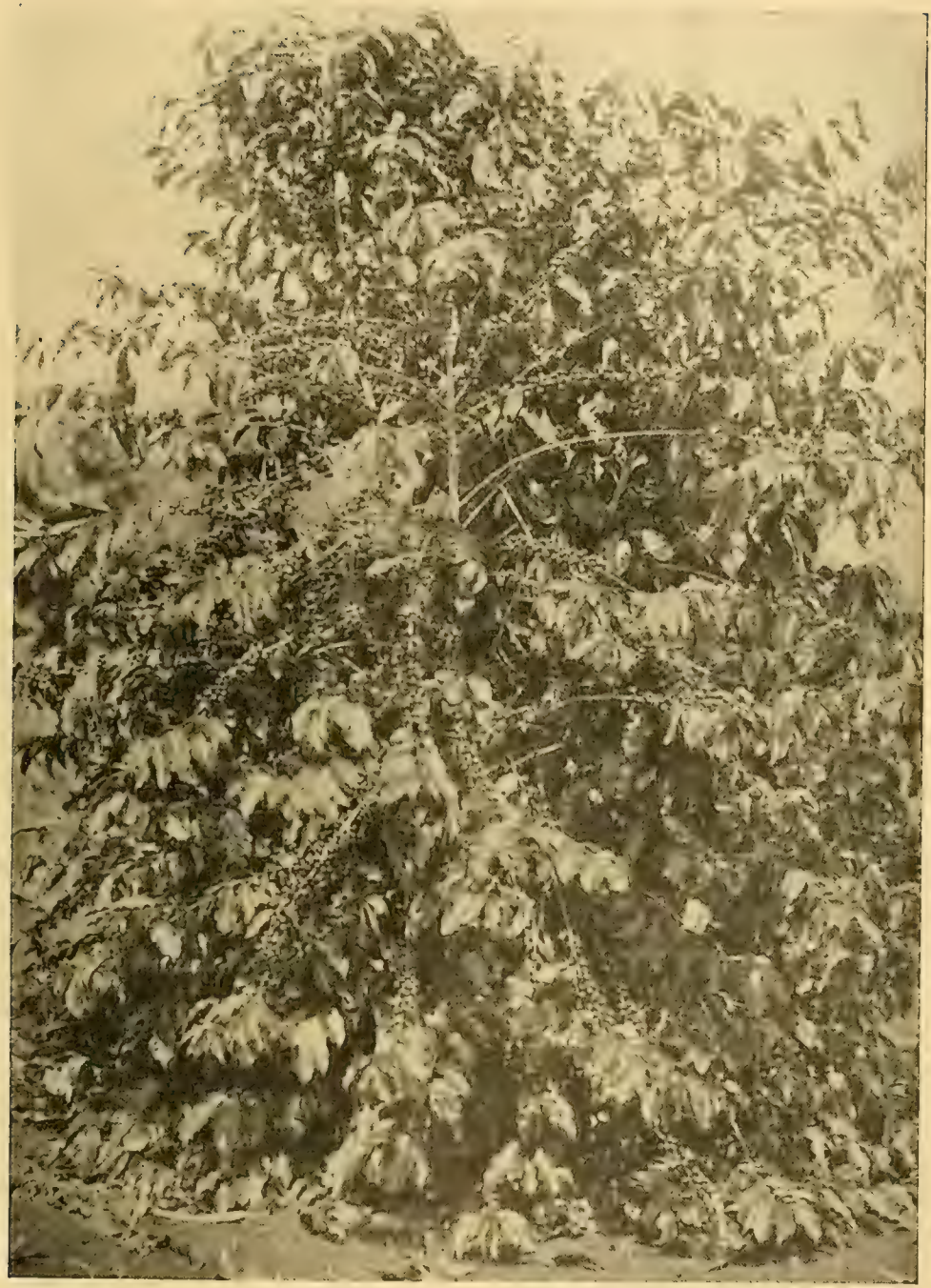


Photo from Mrs Harriet Chalmers Adams

COFFEE TREE WITH BERRIES: NICARAGUA

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WATER VENDER AND OX CART: LAKE MANAGUA, NICARAGUA

Managua was chosen for the capital of Nicaragua in 1855, after a long-continued rivalry between Leon and Granada for the distinction. It is situated on Lake Managua and has a population of about 25,000.

gable for some 240 miles, the last 110 miles of which, however, are only navigable for vessels of light draft.

Lake Nicaragua has an extension of 96 by 40 miles, is navigable throughout for large vessels, and contains a number of islands, of which the island of Ometepe, 12 miles in length, is the largest. It is one of the prettiest and most picturesque lakes of America and the largest in Central America.

Lake Managua, situated but a short distance from Lake Nicaragua, with which it is connected by the Tipitapa River, is 38 miles long and from 10 to 16 miles wide, and is likewise navigable. The capital of the Republic, Managua, as well as a number of smaller towns, are situated on its shores.

Post-offices number 135, and telegraph wires have an extent of 3,150 miles. The United States Government has installed a wireless telegraph station, with a range of over 500 miles, at Swan Island, off the coast of Nicaragua, and the United Fruit Company has a station at Bluefields.

OUTLINE MAP OF ARABIA (SEE PAGE 1039)

NATIONAL GEOGRAPHIC SOCIETY

Wednesday, 7.30 p. m., December 15—Annual Banquet.

Friday, 8.15 p. m., December 17—"The Untamed Girdle of Palestine." Mr Ellsworth Huntington, of Yale University. A two weeks' expedition on the Dead Sea with a canvas boat, a trip to the famous Rock City of Petra, by way of the desolate Ghor, and an excursion to the little-known Negen, south of Beersheba. Illustrated.

Friday, 8.15 p. m., January 7—"Manchuria; the Antung Mukden Railway; the funeral of the late Empress Dowager, November 9, 1909." Miss Eliza R. Scidmore, author of "China—the Long Lived Empire," "Jinrikisha Days in Japan," etc. Illustrated.

Friday, 8.15 p. m., January 14—Annual meeting. Address by Mr John Barrett, Director International Bureau of American Republics. Illustrated.

Friday, 8.15 p. m., January 21—"The Life of the Nest; Studies of the Nesting Habit of Birds." Frank M. Chapman, author of "Camps and Cruises of an Ornithologist," "Bird Studies with a Camera," etc. Illustrated.

Friday, 8.15 p. m., January 28—"The Ottoman Empire." Rear Admiral Colby M. Chester, U. S. Navy. From June, 1908, to May, 1909, inclusive, Admiral Chester lived in Constantinople or was traveling throughout Asia Minor. He was thus a witness of the revoluton and of the beginning of the new era in Turkey. Illustrated.

Friday, 8.15 p. m., February 4—"Mountaineering in a New Switzerland." Professor Charles E. Fay, of Tufts College, formerly President American Alpine Club. Illustrated by personal experiences and views gathered during sixteen seasons passed by the lecturer in the Canadian Rockies and Selkirks.

Friday, 8.15 p. m., February 11—"The Waterways of Empire." Mr. Willis Fletcher Johnson, Associate Editor of New York Tribune. An account of the part which rivers, canals, and other narrow waterways have played in the political and commercial history of the world, and especially of this country. Illustrated.

Friday, 8.15 p. m., February 18—"The Glaciers of Alaska; an Account of the National Geographic Society Expedition to Alaska in 1909." Professor Lawrence F. Martin, of the University of Wisconsin, and, with Professor Ralph S. Tarr, of Cornell University, leader of the Society's Expedition. Illustrated.

Friday, 8.15 p. m., February 25—"The Panama Canal." It is hoped that official duties will permit Colonel George W. Goethals, Chief Engineer of the Panama Canal, to accept the invitation of the National Geographic Society to address the Association on this subject.

Friday, 8.15 p. m., March 4—"Physical Problems of Our Country." Mr Gifford Pinchot, Chief of the U. S. Forest Service. Illustrated.

Friday, 8.15 p. m., March 11—"The Waste of Human Life and Resources in the Mining Industry." Mr Joseph A. Holmes, of the U. S. Geological Survey. Dr Holmes will tell of the Government's efforts to stem the tide of fatalities in which the United States leads the world at a ratio of three to one and the Government's efforts to devise ways of saving the great waste not only of human life but of our coal, gas, and other mineral resources. Illustrated.

Friday, 8.15 p. m., March 18—"A New Era for the South." Dr Charles W. Stiles. The speaker will describe the methods by which science and money hope to eradicate the hookworm or "lazy germ."

Friday, 8.15 p. m., March 25—"The Spirit of the West." Mr C. J. Blanchard, of the U. S. Reclamation Service. The wonderful agricultural development of the West since the work of irrigation was started by the Government and private enterprise. Illustrated and moving pictures.

Friday, 8.15 p. m., April 1—"Patagonia to Paraguay—or the Story of Argentine." Mrs Harriet Chalmers Adams. Illustrated.

Friday, 8.15 p. m., April 8—"The Pearl Fisheries of Ceylon." Dr Hugh M. Smith, Deputy Commissioner, U. S. Bureau of Fisheries. Illustrated.

Friday, 8.15 p. m., April 15—"Nearest the South Pole." Lieutenant E. H. Shackleton. Illustrated.

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